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TUBERCULOSIS PROBLEMS OF TO-DAY

DOCTRINES, CONDITIONS AND NEEDS[1]

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Since the Women's Tuberculosis Society was organized, away back about 1909 or 1910, much water has run under the bridges. The world has become, for better or for worse, a new world. Old things have passed away, and all things have become, or are becoming, new.

In the new learning that has come, and is coming, out of the university of a world at war, there is much about disease and its ways among men. An old volume was closed in August, 1914, and a new one opened; and in that new one there are chapters about tuberculosis which could not have been written in that very old, very far away, time before the war.

Tuberculosis is an old disease—as old as organized human society, as old as houses and villages; but our grandfathers knew little more about it than Hippocrates. Our fathers had a clearer light; and we trust that in our time, the sun has really topped the horizon, beginning a new day. The real burst of new light came with the discovery of the bacillus. From that time knowledge has grown, not only year by year, but even day by day.

About the time this Society was formed, new light, new interest and a new enthusiasm had come to many of us. The enthusiasm may have waned and waxed since that time, but the gathering of to-day still shows a considerable interest in the problems surrounding tuberculosis. The light in which these problems can be viewed is, we think, clearer and steadier than it was. In this clearer light it may be well to state again our doctrines with regard to tuberculosis, to examine the changed conditions which prevail, and inquire into the needs which confront us in this the first year of peace and reconstruction after a world war. We will not find that what we took for truth was really falsehood; but will find, rather, that the emphasis has shifted, and that we will lay our stresses differently.

[1] An address to the Antituberculosis Society of Winnipeg.

In the first place, doctrines. One which was out of date even ten years ago, but which dies hard, is the doctrine that tuberculosis is largely a matter of heredity. It is true that, if a fortunate child could be consulted in the choice of his parents, as Maeterlinck suggests in his latest play, he should choose the perfectly healthy rather than the somewhat tuberculous. He would be apt to get a better physical backing from a healthy than from an unhealthy parentage. At the same time even though born of parents who are affected by tuberculosis, he is almost certain to be born free from actual disease. He may have a physical handicap, but we believe he has not got tuberculosis. If, later, he acquires the disease (and he has special opportunities for so doing), it is from contact, after birth, with tuberculous persons, parents or others. The boast that "tuberculosis has never been in our family" is good as far as it goes, and is in favor of a rugged ancestry, but gives no guarantee that tuberculosis may not appear in any family. On the other hand, a family history of tuberculosis, while it may mean an inferior physical backing, is no decree of fate, and the family record may be improved and even reversed by study and care. Where many in a family have developed tuberculosis, heredity is by no means proved. A common parentage is just one of many factors common to the members of one family.

More and more we think of tuberculosis as a universal disease; universal not only in the sense that it is found in all countries, among all classes, and under all conditions, but universal in a wider sense, in that it becomes implanted at some time and to some degree in practically every individual. Childhood is the usual time for implantation, the seed time; adult life is usually the time of breakdown, the harvest. At the age of leaving school there are possibly few children who have entirely escaped infection and latent disease. Seven out of ten thus infected likely pass through life without any illness due to the tubercle bacillus; two may have more or less trouble, and overcome it successfully, and one may not overcome it. That is, out of ten who have early infection which leaves latent tuberculosis, three may later have the disease tuberculosis, and one may die of it. When we hear of one who has developed active tuberculous disease, we don't ask, "Where did he catch it?" but we do ask, "How was his resistance lowered so that the disease 'got' him?" It is not infection, but lowered resistance and breakdown that sets the date for the onset of disease in adult life.

Some Manitoba farms have many noxious weeds, and some very few. As a rule, a good farmer has a clean farm, and a careless farmer a weedy farm. Weeds always impair crop and sometimes utterly destroy it. A good clean farm, if neglected for one season only, left untilled and unsown, grows up a mass of weeds. Where did these weeds come from? Were they sown by the hand of an enemy? Were they blown over from the surrounding lands? No; they were in the soil already, seeded there, rooted there, waiting only an opportunity to grow, and that opportunity the careless farmer gave them. The weeds were not planted during the year of neglect; they were latent in the soil, ready to find their opportunity in any year or any month of neglect. There is not a quarter section of cropped land in the whole of Manitoba which has not latent seeds enough and roots enough of noxious weeds to grow a veritable jungle of weeds if the farm be neglected.

Tuberculosis is a human noxious weed lying latent in practically all human soils, finding its opportunity for growth in some bit of bad human husbandry, some over-strain, some over-fatigue, some dissipation, some neglect, some lowering of vitality through illness. When one presents himself with signs of tuberculosis, we do not trouble to inquire about infection. We inquire as to the particular kind of bad farming, the particular cause of breakdown.

What our beliefs are is a matter of great consequence, for according to our beliefs our acts will be. If one believes that sow thistle or tumbling mustard is destined, in spite of all efforts, to destroy a certain crop; or that tuberculosis, having been in the family in a past generaction, is inevitable in this generation, as the family ghost or the family features, there is not much to do about it. Kismet—it is decreed.

If one believes his own farming faultless, but that all weeds come from his neighbors; or that he alone is free from tuberculous infection and all other people are a menace to him, he is going to be a very uncomfortable person, and a very irritating and unfriendly neighbor. One of the most uncomfortable phobias is the unreasoning and unreasonable fear of becoming infected by tuberculosis.

But when one believes that tuberculosis is an almost universal *infection*, an almost universal latent *condition*, though by no means a universal *disease;* that the latent condition becomes disease, not by accident, but by living and working under improper conditions, or in improper ways; then any anxiety we may have about keeping ourselves, or our families, our kinsfolk and acquaintance, our community, our

country, from the devastations of tuberculosis will take the practical and useful form of improving home, shop and community conditions and personal and community habits, in order to lessen the ravages of tuberculosis. Rightly considered, tuberculosis is more a social than a medical problem; less a disorder of the individual than a disorder of the community. Born into the world free from it, the child acquires it without his knowledge or ability to prevent. Its activity or inactivity, as the child unfolds into the adult, will depend upon such things as his tonsils and adenoids, his mouth breathing or nose breathing, the ventilation of his home and shop, the size of his house, his degree of intelligence, his education, his personal hygienic habits, and the hygienic or unhygienic habits of those with whom he is associated. It will depend upon his work, and possibly still more upon his play, upon his hours of work, his hours of rest, his holidays, his recreations, upon the burdens he carries. It will depend upon the epidemics which visit his community, upon clean or dirty streets, well- or ill-regulated public places, on milk supply and food regulations, upon costs of necessaries of life, upon war or peace, on marrying and giving in marriage: indeed on all conditions—hygienic, social, personal and financial—which enter into his life.

The death rate from tuberculosis in England rises and falls with the price of bread, a staple article of diet. The death rate from tuberculosis in families living in one or two rooms is twice as high as in families living in five or six rooms. The city of Liverpool cleaned out a bad tenement district many years ago to stamp out typhus fever, and found that, in the better houses which replaced those destroyed, the death rate from tuberculosis had lessened as well. The water carriage of sewage, and every sanitary reform, every improvement in living conditions, have had a definite influence on the tuberculosis death rate. In Manitoba, the settlements in which tuberculosis is most prevalent are those in which living standards are lowest, where ignorance is general, houses small, sanitary conditions bad, overcrowding common, work hard, the average of wealth low; old settlements of ignorant and unmodern type; foreign un-Canadian settlements, out of touch with modern movements; pioneer settlements, in which there is more or less privation. Such settlements in Manitoba have a death rate—as shown by an investigation made a few years ago—six times the Manitoba average. On the other hand, prosperous settlements, where houses are good, circumstances easy, people intelligent and modern-minded, sanitary con-

ditions good, crops good, mortgages few—some such settlements were found to have a death rate one-sixth the average provincial rate. If statistics were absolutely reliable (as they are not), one might say that the worst settlements in Manitoba have a death rate from tuberculosis thirty-six times as great as the best settlements.

The medical history of a broken leg may be given in a short paragraph. The medical history of the onset of typhoid fever may be given almost as easily—a healthy person ate or drank infected material and became ill. But the medical history of a breakdown from tuberculosis, to be complete, involves a study of almost all that a man has ever done or has ever been subjected to. It is, in the words of Ulysses, "A part of all that he has met." Tuberculosis is not a patch on the fabric of life—it is woven into the warp and woof of life.

The doctrine to which we adhere firmly, that all of us have at least the makings of tuberculosis, and that wrong living makes latent disease active and possible disease real, is one which leads to a direct and definite interest in all aspects of personal, family and community life. An interest in tuberculosis, it follows, so far from being a narrow one, can be one of the widest. The fact that tuberculosis develops out of social conditions, even more definitely than out of physical conditions, makes the campaign a very broad one—connects it up with every movement for the betterment of living conditions. To one who thinks tuberculosis, nothing in a community is without relevance or interest. It follows also that the best campaign against tuberculosis is not necessarily a direct campaign. Preaching the badness of sin and the fear of hell-fire is not considered as good a way of soundly converting people as the preaching of the beauties of goodness. More antituberculosis work may be accomplished by helping on a good housing movement, or teaching the use of the toothbrush to children, or finding adenoid growths and having them removed, or ringing a curfew bell to get children to bed, or voting against any daylight saving which keeps them out of bed, or setting a fashion against over-elaborate housekeeping; more, possibly, may be done in such ways than by lurid lectures about the tubercle bacillus and all its badness. Indirect illumination is the best. Frontal attacks are not always effectual. The victory over tuberculosis may be won by advances on other fronts.

WHAT ARE PRESENT CONDITIONS WITH REGARD TO TUBERCULOSIS?

There can be no doubt that the general public is much more interested than it was ten years ago, and possibly even better informed, though it would be difficult to suggest any subject of popular discussion about which there is as much general misinformation. Unfortunately deep interest sometimes goes with the greatest amount of misinformation, and many people are really interested in tuberculosis problems who still think the disease exists only in those who are definitely ill; that it is commonly contracted by adults; that it is properly treated, no matter what the condition, by unlimited tramping about in the open air, and that it is always fatal (as, of course, could be expected from such treatment). To correct misinformation, the only agency is truth. Truth is mighty, and we hope it will in the end prevail. The amount of teaching we do about tuberculosis is not so important as that it be accurate and true. It was said by the Greatest of Teachers, "Ye shall know the truth, and the truth shall make you free." The truth about tuberculosis is the best antidote for the unreasoning and unreasonable fear of the disease which makes the life of many an otherwise sensible person a burden.

It can be said with truth that conditions are improving in Manitoba. There are still nearly 500 deaths a year from tuberculosis, or about 85 for every 100,000 population; but that is about the lowest death rate in Canada, which we share with Ontario, Saskatchewan and Alberta. Compared with our 85 per 100,000, Montreal and Quebec have each over 200, New Brunswick and Nova Scotia each about 170, Canada as a whole about 140, different portions of the United States, east, west, north and south, from 100 to 300, and the whole country about 160. England's rate is about 140. In some parts of South America, in the Philippines, and in other countries in which living conditions are bad, the death rate per 100,000 ranges from 300 to 600; that is, up to nearly seven times the death rate of Manitoba. The lowest death rate on this continent is in the provinces of Ontario, Manitoba, Saskatchewan and Alberta. Rates in the Coast States and the Southern States are very high in comparison.

On the whole, the proportion of one death in every ten due to tuberculosis still holds; and it is approximately true that in all the countries at war, during the past four years, tuberculosis has resulted in as many casualties, as many deaths, as war. Unnecessary deaths, among which

deaths from tuberculosis are included, mean a yearly financial loss to Canada of $150,000,000, and to the United States of two billions of dollars. In North America, deaths from preventable diseases, including deaths from tuberculosis, are 690,000 per year. And death rates, which have been falling for a generation, will be raised again—it may be for several years—by the influenza scourge.

Among conditions of to-day to be considered in connection with tuberculosis are those growing out of the war. When, in 1914, the brazen clarion summoned the youth of all nations into armed camps, it was considered that an immense breaking down of resistance and an appalling increase in the ravages of tuberculosis would result. It is quite true that many have been broken down through the spread of epidemic diseases in barracks and camps, by bad camp and unutterable trench conditions, by fatigue beyond human endurance; and yet the number so broken down and made tuberculous is not so great as was anticipiated. It is balanced to some extent by the number of those who were actually improved physically by the drill, the regular life and the outdoor work; so that it has been repeatedly stated, by those in a position to make an estimate, that the incidence of tuberculosis has not been greatly increased, if, indeed, at all, by war, so far as the soldiers are concerned. It has been increased lamentably in the civilian population of every territory over-run, and even in the civilian population of Britain.

Contrary to the popular belief, asphyxiating gasses—the most horrible of all weapons of war—have not been in any measure responsible for tuberculosis. Having been gassed does not result in becoming tuberculous.

Again, in opposition to popular belief, actual infection of one soldier by another has not been the cause of war tuberculosis. Disease which became active in war was latent before the war. As Osler has said, "the germ enlisted with the soldier." Debilitating conditions inseparable from war, the widespread common colds and uncommon colds, influenzas of all sorts, measles, whooping-cough, mumps and other epidemic diseases have stirred latent tuberculosis into activity. They have stirred up other respiratory diseases as well. Thirty-three per cent of soldiers returned to Canada, suspected of tuberculosis, have been found to be non-tuberculous. Early in the war France lost two divisions—about 86,000 fighting men—by classing them as tuberculous; whereas closer diagnosis, under better conditions, showed that only 20

per cent of them were tuberculous. Much pulmonary disease, apart from tuberculosis, has come out of the war.

It is along this line that the war has had much to teach about tuberculosis. Skill in diagnosis has been greatly increased, and the hazy line between tuberculous and non-tuberculous respiratory diseases has become more clearly defined than ever before.

Whatever increase there may have been in active tuberculosis during the war may possibly be compensated for by a correspondingly low rate in succeeding years. This was found true following the Franco-Prussian war. It is argued that those who would in time have broken down anyway broke down earlier than they otherwise would have done on account of the war strain, and so breakdowns may be fewer for some years to come.

Among new interests aroused by the war, a renewed interest in tuberculosis is certainly one. It has resulted in the expenditure of large sums of public money in buildings for the care of tuberculous patients, and for the cure of these patients. It has established the treatment of tuberculous patients to an extent that it never was before as a public duty, and a matter of concern to governments. The war has led us to the verge of a new conception regarding illness, its care and cure. If the wounded or tuberculous soldier be cared for until he is well, or helped indefinitely if he should not return to complete health, it is not difficult to argue that the soldier of commerce, of industry, or of agriculture, when disabled, should be cared for in the same way. If the man who fights abroad is to be provided for in illness, why not the woman whose work and child-bearing have broken her down at home; and why not the child, the worker, or, if a stern need should arise, the fighter, of the future?

If tuberculosis has not been greatly increased by war, it may be asked why so great increases were necessary in buildings for the treatment of the disease. It may be, at least in part, because, among mobilized men, practically all active cases enter sanatoria, besides many suspects who are really non-tuberculous. This sudden increase in our sanatorium population is not alarming if, without increasing our morbidity, we are simply increasing the proportion of our cases under institutional treatment. Indeed, that is just what for many years we have been trying to do.

Out of war tuberculosis, there may come good as well as evil. There has, indeed, come already a better and clearer understanding of the

disease, more accurate diagnosis, a more general resort to treatment in early cases, more and better equipped institutions for treatment, a juster idea of the place of the tuberculous man in the community, and a fuller utilization of the by no means inconsiderable capacity of even the definitely tuberculous man for service.

We are beginning to fear that, though war has claimed its thousands and tuberculosis its thousands, the pestilence that walketh in darkness, and the destruction which wasteth at noonday, may destroy almost its tens of thousands. In the United States, which, of course, was not hard hit in the war, influenza has killed ten times as many as the war. In one Manitoba community it destroyed one per cent of the population; in Pittsburgh, nearly seven-tenths of one per cent; in Philadelphia, three-quarters of one per cent; in Boston, one-half of one per cent; and in Winnipeg, nearly 1,200 deaths have already been reported—about six-tenths of one per cent of the population. In seven years tuberculosis would not cause as many deaths in Winnipeg as influenza in two months. That means the depletion of the community by influenza was forty times as rapid as by tuberculosis.

Influenza, which seems to linger in the mountains of Asia, issuing forth at irregular intervals and riding like a foul spirit over the world, breathing poison into the faces of men, has been well called a "mystery disease." Its relation to tuberculosis is not more certain than its other relations. There is an idea that tuberculous people are passed over easily. It seems true that most handicapped people are dealt with more easily than would be expected. It is my idea, however, that it is not the tuberculous person who is passed over easily, but one who follows the tuberculosis routine, who lives the open-air life, avoids excesses, and keeps energy expenditure well within energy income. The tuberculous person who lives wrongly, who over-spends his energy, who becomes tired and lowers his resistance, will certainly not be exempt, but likely be very hard hit. The influenza epidemic undoubtedly touches a match to old latent tuberculous conditions and lights up tuberculous disease in many for the first time.

I have discussed *doctrines* and present-day *conditions*, and have now to mention *needs*.

One of the most urgent needs, the need of information to replace misinformation, has already been emphasized. It would seem to me that papers on tuberculosis, the disease, its causes, its treatment, and the results of treatment, would not be out of place in this Society. I am

sorry to say that even medical associations and associations of nurses are not beyond the need of papers of this sort, and for the same purpose of better information.

Since tuberculosis bears a definite relation to almost all that enters into family, personal and community life, such a Society as this could very properly discuss the relation of tuberculosis to other community problems. Such studies might be made of tuberculosis and housing, tuberculosis and hours of labor, tuberculosis and the pay-roll, tuberculosis and strikes, milk and tuberculosis, food inspection and tuberculosis, the school and tuberculosis, personal hygiene and tuberculosis, tuberculosis and the common "cold," tuberculosis and maternity, tuberculosis and war, the factory and tuberculosis, tuberculosis and city cleaning, tuberculosis and recreations, which last might be one of the most important. Not only would such studies develop and fix the ideas of the members, but they might enable the Society to speak its mind on these associated questions, and, in a way, poll its vote in favor of better conditions.

Not only knowledge is needed, but a real interest—an interest that goes beyond pity. It is a great thing to pity and help the down-and-out, the hopeless, the man with staggering gait and hollow cheek; but interest in preventing the making of tuberculosis may be even more important than interest in the unmaking of it. Prevention is a bigger matter than cure. It does not take much imagination to see the needs of the very ill, but it takes more imagination to see the ways in which the community life may be bettered and the world made safe for life as well as for democracy.

All visiting of sick people requires knowledge and tact; but the visiting of those who have tuberculosis, especially if the visitor dares to give advice, requires very definite knowledge about the disease. For instance, the venturing of an opinion by the visitor as to how much the patient should do, and how much he should rest; whether he should read or write, or receive visits or not. Such matters are definitely involved in the treatment of tuberculosis, and right or wrong advice is fraught with fateful consequences.

There may be room even yet, among all campaigns of all sorts in this age of campaigns, for a little more definite campaigning with regard to tuberculosis. I am sure, for instance, that the poor, overburdened school children, attacked by all campaigners, have not yet been sufficiently taught with regard to tuberculosis. I do not ask for

instruction with regard to the disease. The best instruction would be that in which the name of the disease was not mentioned and the disease scarcely hinted at, but that which would teach, for instance, that it was neither hygienic nor gentlemanly nor ladylike to expel the secretion of nose and throat, by coughing or sneezing, into the faces of other people.

The war has brought to light in all countries undreamt of resources of man-power, woman-power, money-power, enthusiasm, patriotism, self-sacrifice, altruism, organizing ability. If even a tithe of this great stream can be directed into the problems of reconstruction and better construction of our whole social fabric, the world should be a better world for the next generation, almost, than we have ever dreamed of.

War is not over; the clash of arms will give place to rivalry in commerce, in industry, in productiveness; and, if we are to cope with other nations, the master words for us must be *conservation* and *efficiency.* Waste of our material resources, of our soil, our forests, our mines, our products, our cities and towns by fires, will cripple and handicap us in the race; but most of all will we be handicapped by the wasting of our human resources, the lives, the strength, the health, the vitality of our men and women, our sons and our daughters. Conservation of health and strength, and time, comes to be high patriotism. National health is national wealth, and means national prosperity. We must gather up the fragments that remain, that nothing be lost. Let us carry into a campaign, for stopping the national waste from unnecessary disease, all the strength of purpose the war found and fostered within us.

THE TUBERCULOSIS PROBLEM IN SAN FRANCISCO[1]

GEORGE H. EVANS
San Francisco

At the end of the first decade of organized effort in the tuberculosis campaign in San Francisco, it would seem an appropriate time to pause and take careful inventory of the situation as it presents itself at the present time. Measured by results accomplished, have the efforts of those who have been actively engaged in this work been worth the endeavor? Has the expenditure of the funds necessary to carry on the work been justified by a corresponding amelioration of the conditions which were present when the work started? Have misdirected efforts on the part of those active in the work brought the total of achievement far below where it would have been had the various activities operative in the campaign been more intelligently correlated? Have some of the fundamental problems been overlooked in the endeavor to meet and deal with what seem to be the pressing needs?

There is a universal tendency to evaluate endeavor in terms of mortality and morbidity statistics. A lowered death rate is too frequently attributed to the activity of educators and propagandists where more careful analysis would present facts tending to refute these claims. Doctor Palmer of Illinois has recently in striking manner called attention to the error of too hasty analysis of such statistics, and has shown from the figures of Hoffman that while the death rate from tuberculosis showed a decrease of 30 per cent during the twenty years following the beginning of the organized campaign in this country, the preceding twenty years showed a decrease of 27 per cent, almost as great as that of the two following decades. In fact Hoffman's figures show a rather steady decrease in New York, Philadelphia and Boston for the past hundred years; "the more decided decrease beginning about 1881, or eleven years before the first organized tuberculosis work in America, but, incidentally, at about the time of Koch's discovery of the tubercle bacillus."

In order to understand the San Francisco problem better it will be necessary to review briefly the situation existing for some years prior to

[1] Read at the Southwestern Tuberculosis Conference, Long Beach, California, October 1 to 3, 1919.

the decade just past. The city had the unenviable distinction of having the highest death rate from tuberculosis, with probably one exception, of the ten most populous cities of the nation. No organized effort had been made to study the problem. Such relief as was given to needy cases was done by the Associated Charities and other charitable societies. The municipality took no cognizance of the situation. There were no hospital wards for the tuberculous prior to 1907. There were no clinics. Tuberculous patients entering the general medical clinics were indifferently examined without investigation of living conditions. There was no social service. There was no housing inspection although there were large areas of insanitary overcrowded tenements and houses in the "North Beach" and "South of Market Street" districts. The criminal negligence of the municipality was no greater nor more far-reaching in its baneful results than was the criminal apathy of its citizens who allowed this condition to go on without any effort at abatement.

In 1906 the Great Fire wiped out completely the tenement districts of the city. The golden opportunity presented by this devastation was sacrificed in the effort of rehabilitation. Insanitary and overcrowded tenements quickly were reared on the embers in response to pressing housing requirements. A small group of citizens succeeded in securing some housing legislation, but lacked the machinery for enforcing its provisions on an unsympathetic municipality frenzied in its effort to again place the city on the map.

Late in 1907 it was realized that bubonic plague was present and the struggling city was threatened with Federal quarantine. The situation became so acute, that, acting on the initiative of the State Medical Society, the citizens organized; and through the activity of the Citizens' Health Committee a sanitary campaign was inaugurated and carried through to a successful issue. Sanitary regulations of the most drastic nature were enacted and enforced because the entire community was aroused through a wholesome fear of the dire consequences which impended. Plague was eradicated from San Francisco by a campaign of publicity, a campaign in which the coördination of all the industrial and social organizations of the city was so complete, that it probably stands out as the best example of successful health campaign that has been witnessed by the nation.

In the summer of 1908 the organization of the San Francisco Association for the Study and Prevention of Tuberculosis which had been interrupted by the disaster two years before was brought to completion.

It at once became evident to the organizers that there were several problems more or less fundamental, which pressed for immediate consideration. As the basis for the development of a comprehensive campaign some sort of survey was necessary to the end that information could be acquired relative to the incidence of tuberculosis and the discovery of areas of greatest infection. It was necessary to correlate and centralize the various clinics and develop an efficient social service department. An educational campaign had to be inaugurated that would be effective in creating a popular demand for legislative relief from many of the conditions which existed, and which would produce a general understanding of the objects and necessities of the organization. It was necessary that an affiliation with other organized bodies be created whereby concerted action could be taken relative to a comprehensive study of the housing problem. An immediate amelioration of the disgraceful conditions surrounding the care of the tuberculosis patients at the City and County Hospital was demanded. This comprehended a program worthy of organized effort, and a devoted group of workers started to build the foundation on which to erect a creditable superstructure.

The organization of the clinics became the immediate concern of the association. After much deliberation and consultation with other bodies and agencies active in charitable work, and with the coöperation of the medical schools and other dispensaries, it was decided to attempt centralization of the various clinics in order that more uniformity could be attained in the efficient handling of these patients than was being accomplished in the various outpatient departments scattered throughout the city. Centralization was also necessary for the more effective and rapid development of a social service department without which clinics served little purpose. The various clinics through this affiliation sacrificed no autonomy; each appointed its own clinician; and the clinics representing the medical schools were free to use the clinical material for teaching purposes. The clinics were merely housed by the Association, which financed the affiliation.

At the outset it was fully recognized that centralization was necessarily a temporary plan; that, as the work developed and the clinics grew, it would be necessary to provide branches geographically situated to meet the growing requirements; and that the academic work of the medical schools would ultimately require that their clinics be merged with their general outpatient departments. It was believed, however,

that the proper inauguration of the work required centralization. The work accomplished has abundantly justified the decision of the promoters. Five clinics affiliated at once, and this number was soon increased to seven. The growth of the clinic has been satisfactory. A branch clinic in the Mission District was inaugurated in 1916; the two medical schools have transferred their clinics to their general outpatient departments, the affiliation remaining; two night clinics have been established; a Chinese clinic is in operation in the Oriental Quarter; and a children's clinic has been opened in the Mission. The Association is looking after about 1200 cases at the present time.

Starting with two nurses the social service work has endeavored to keep pace with that of the clinic, with the result that there are now five Association district nurses and three social service workers, the salaries of the latter being paid by the City Health Department. Too much cannot be said of the efficiency of these nurses. The living conditions of the clinic patients have been investigated and, by actual house to house canvass in many districts, late stage cases have been discovered, patients removed to the tuberculosis hospital, and children taken from insanitary homes and places found for them where they could grow and develop under more favorable hygienic environment. The good work accomplished in this field has of course been limited by the fact that the staff of workers has not been much larger.

While it has not been the policy of the Association to use its funds for the giving of relief, several hundred dollars are expended yearly to meet urgent needs when relief could not be obtained elsewhere. Relief has been supplied mainly through the coöperation of the various charitable organizations throughout the city.

It was recognized at the start that the morbidity statistics of tuberculosis in the city were defined in terms of the mortality reports. Physicians generally were not reporting their tuberculous patients. The profession was circularized by the Association urging coöperation in this respect. The result was shown in the fiscal year 1908–1909 by the fact that the morbidity figures approximately doubled those of the mortality rate. This ratio has practically remained unchanged to the present. Doctor R. W. Philip of Edinburgh has concluded as the result of elaborate calculation on this point that the total number of active cases of tuberculosis in any district is about ten times the number of deaths from the disease. If this calculation is even double the actual number the fact remains that in San Francisco as in many large cities

the vast majority of open cases remain beyond the reach of organized effort to find them.

In 1909 the Legislative Committee of the Association secured the introduction of a comprehensive tuberculosis measure in the Board of Supervisors which became an ordinance. This law enabled the authorities to enforce compliance with regulations for the handling of the tuberculous, and gave them police power in the forcible removal to a place of isolation of such patients who, by their refusal to comply with the regulations of the ordinance, menaced the health and welfare of others.

Educational propaganda has not been neglected. Much literature has been distributed; but better practical talks have been given to groups of employees in shops, factories, department stores and meetings of labor organizations. Medical examination of employees has been carried on as far as the coöperation of employers could be obtained, and the machinery for the work be provided.

In July, 1915, the Association submitted a preliminary survey of the situation to the Department of Public Health. This report contained much valuable information relative to the problem, obtained at considerable cost of time and labor over a period of three years. It presented several recommendations among which was the creation of a special Tuberculosis Bureau of the Department of Public Health with suitable appropriation. The activities of this bureau contemplated the coördination of the clinics and many of the functions carried on by the Association as part of the municipal public health problem. It provided for the enforcement of the regulations of the tuberculosis ordinance and for the carrying on of investigations relative to the living and working conditions of the people. It placed squarely before the city government its responsibility toward the prevention of tuberculosis and emphasized the fact that the burden of the work should be borne by public appropriation rather than private charity. Provision was also made in this report for more adequate hospital facilities for advanced cases. This included a two hundred bed sanatorium for early cases, and the care of tuberculous children—a hospital for active cases and preventorium for the physically subnormal. The necessity for open air schools was urged.

San Francisco has lagged behind in the development of open air schools. In a city where climatic conditions lend to the practicability of such institutions, this lack is cause for serious criticism. In 1916

the Association, with the coöperation of the Board of Education, started the first open air school. This affords accommodation for twenty-five pupils, the expense of which, with the exception of the teacher, is borne by the Association. Another has recently been opened in the Mission District. The expectation that the results accomplished by the successful operation of this experiment would impel the Board of Education to realize the necessity of instituting such schools in other districts where they are sorely needed has not been realized.

The San Francisco Hospital. The city provides hospital facilities for between 250 and 300 cases in the tuberculosis department of the San Francisco Hospital. This department comprises a new wing of the general hospital, recently constructed at a cost of about $400,000, and consists of a four-story brick building, fairly well equipped, with both open and closed wards. The general administration is in charge of a superintendent, the medical service being supplied by visiting physicians from the two medical schools. As the city has no sanatorium provision for early cases, this department, intended only for late cases, is largely occupied with those who should receive sanatorium care. This results in long waiting lists of those who in the interests of public health should be cared for by the city, and isolation of the late dangerous cases is largely defeated. This has given rise to much just criticism, and the hospital care has been the storm center about which the forces engaged in the tuberculosis campaign have waged incessant warfare. There were 899 deaths from tuberculosis in San Francisco in the fiscal year ending June 30, 1917, a relative death rate of 194.1 per 100,000. Admitting the general accuracy of the estimates of Philip and others relative to the incidence of active disease as compared with mortality, San Francisco probably had in that year nearly 9000 active cases. Of this number, the advanced cases requiring hospital care could conservatively be estimated at nearly 1000. San Francisco is providing hospital accommodation for only about 25 per cent of those who should be isolated. As a large proportion of those who should be in hospital are old fibroid cases which should be cared for elsewhere in different types of institutions, or cases suitable for sanatorium care, it will be at once apparent that the problem of the segregation of the advanced hopeless case is far from a satisfactory solution. When the hospital problem is viewed in the light of results obtained the economic waste becomes very apparent. A recent canvass of the inmates demonstrated the usual preponderance of unskilled laborers among the

men, and of housewives and domestics among the women. Of those who improve sufficiently to leave and go back to their various employments, what is the ultimate outcome? The Social Service Department, with its inadequate force, is doing all it can to follow up the discharged cases; many become patients at the Association clinics; more wander away to break down under the effort with their partially arrested lesions, to earn their living; and a large number after absence of varying periods return to the hospital, broken down in body and spirit. Numbers of such patients have been intermittently inmates half a dozen times or more. Something is fundamentally wrong with a system which is productive of such economic waste.

Sanatorium. After much conference, and much expenditure of time in search for a suitable site, the sanatorium problem is apparently as far from solution as ever; and the initial appropriation of $50,000 included by the Board of Supervisors in last year's budget for this purpose bids fair to be left out of the present budget. There is much difference of opinion among tuberculosis workers concerning the relative value of the sanatorium as a factor in the campaign. Doctor Livingstone Farrand on one occasion said to me that he considered it the most expensive and, at the same time, the least efficient weapon in the war against the White Plague. No one who has visited the sanatorium at Frimley, and has seen the splendid work of Doctor Paterson, has failed to be impressed with the immediate results of rest and graduated exercise. What of the ultimate results? On the occasion of a visit there a few years ago Doctor Paterson admitted that practically all the arrested cases failed in their effort to maintain their health when returned to the living and working conditions in London under which they had originally broken down.

Of 1056 patients discharged from the Massachusetts State Sanatoria from May 1912 to May 1914, 45 per cent had died by December 1916, according to an investigation conducted by Hawes. This report does not state the percentage of deaths due to tuberculosis.

The condition of patients twenty years after discharge from the Trudeau Sanatorium is treated in an interesting manner in the Thirty-fourth Annual Report of that institution recently published. The significant summary of this report is that of 814 traced patients, 666, or 81.8 per cent, are dead, the vast majority of whom died of tuberculosis. It is not my desire to minimize or bring into question the value of the sanatorium, but I believe the time has come when we

should temper our enthusiasm, and, I fear sometimes our impetuosity, by intelligent conservatism; and endeavor to discover wherein the work of the sanatorium is deficient. Why are the benefits acquired at such an expenditure of money and energy so temporary in their results that such large numbers of the graduates of sanatoria fail to carry on? This is a pertinent question and may well engage the serious attention of tuberculosis workers everywhere.

An attempt has here been made to present a summary of some of the activities of those interested in the tuberculosis problem in San Francisco during the last decade. The fallacy of attempting to evaluate results in terms of mortality statistics is very evident. The death rate has fallen from an average annual rate for the years 1906 to 1910 of 208.9 to 193.6 per 100,000 of population for 1916. These are the latest available figures as published by the Bureau of the Census. This compares favorably with the statistics of many of the large cities of the nation, and in fact with the relative decrease in the entire registration area. It is interesting to observe in this connection that the only two cities in the group considered which have shown an increase in the mortality rate from tuberculosis during this time have been Cleveland and Buffalo, which cities have been at the front in organized warfare against this disease. This emphasizes the fact that rapid decrease in mortality is not to be expected in the future as communities approach the minimum. The two cities mentioned have enjoyed an unusually low death rate since 1900. When we thoughtfully analyze the decreasing death rate since 1882 as shown by Hoffman's figures presented to the National Association in 1913, a decrease commencing a decade before any organized campaign was instituted, we are impressed with the fact that other agencies have been factors. As expressed by Palmer:

> Coincident with the descending curve in tuberculosis mortality, people were living cleaner, better and more wholesome lives and interest in general health was steadily increasing. While we were passing through our early hysterical fear of infection in our frenzied battle with the tubercle bacillus, and were awakening from our over-colored dreams of short cuts to cure, scores of medical and social agencies were coming into life trying to solve the problems of better living and of better health. We must consider to what greater extent these forces and agencies may be employed in continuing that curve which is still too far from the bottom of the scale.

It would be well now to turn our attention to some aspects of the problem which seem fundamental and yet have not generally received the serious consideration their importance demands.

The necessity of correlation of the various medical and social agencies in the community into a federation similar to the Cleveland plan is at once apparent. This lack of coördination has been a great obstacle to the work in San Francisco. Too much attention has been concentrated on the struggle against the bacillus, and the importance of uniting all activities in the community which strive for better living conditions has not been sufficiently recognized.

Antituberculosis associations generally have been slow to throw aside tradition and shape their course by the beacon lights kindled by the revelations of modern phthisiogenesis, which have presented the prevention of tuberculosis in a new form. Many of our old texts have become mere platitudes. Several years ago Trudeau said to me that we have taught the people so much that is erroneous about tuberculosis that we must now begin to "unteach" them. Much has been said and written regarding the care of the child. "Tuberculosis is a disease of childhood" has become as familiar a phrase as that "tuberculosis is a house disease;" and yet we prattle these terms in our Association meetings and medical societies, while our infants are continuously exposed to the massive infections which result either in the shameful mortality from tuberculosis which occurs in the first year of life, or in the implantation of the lesion which ultimately presents the problem at puberty or in the adult.

Modern phthisiogenesis teaches us that the child is born free from tuberculosis but without any of the protection from the bacillus which we call immunity. The tubercle bacillus is ubiquitous and infection is inevitable as is shown by the increasing evidence of infection up to fourteen years, when 90 per cent of all children react to tuberculin. Infection after infancy does not result in the high mortality seen in the first two years of life, but on the other hand produces frequently a mild infection which protects or vaccinates against the disease in the future. The infant under two years of age should be protected against tuberculous infection at all costs. This presents a problem radical in its nature and drastic when considered from the standpoint of measures for carrying it out. Much has been done for the care of the already infected child, and the preventorium has become a very popular part of our propaganda. What of the protection of the infant? Aside

from the experiment of Doctor Hess in New York, I know of no other organized effort to meet this fundamental problem. If some of the misdirected energy expended on an attempt to chase the bacillus in the adult could be transferred to constructive effort to protect the infant from infection, a great gain would be made toward the ultimate goal of our endeavor.

Industrial communities. No adequate plans exist for the aftercare of the sanatorium patient. We have been reluctant to recognize the fact that arrest of disease in the clinically tuberculous does not mean cure. Until tuberculosis workers generally are brought to a realization of the truth that those, whose tuberculous infection has advanced to a stage of clinically recognizable tuberculous disease, will in the vast majority of instances never be able again to enter the channels of normal industrial competition, the sanatorium and other agencies created for the treatment of the tuberculous will lack the machinery for making their work effective. If the work accomplished at such expense by clinics and sanatoria is to be justified by results which endure, then suitable provision must be made for the institution of industrial communities for arrested cases. I take this to be at once one of the most fundamental problems that the future of antituberculosis work presents. Much impetus has been given this by leaders in the campaign during the last two years. The farm colony idea has developed into the more comprehensive plan of industrial community with increasing realization of the fact that the future welfare of the arrested case depends upon the securing of work for which the patient is fitted and has been trained; that the labor of the artisan and mechanic must be subsidized to the end that his productive power shall be kept within his physical limitations. Opinion is being rapidly crystallized into a working program respecting this problem and is presented in tangible form in a recent study by Doctor H. A. Pattison, made under the direction of the Advisory Committee of the National Tuberculosis Association.

What of the future? San Francisco is less fortunate than many of its sister cities throughout the nation in that it has an unawakened civic conscience. It has not been brought to recognize that tuberculosis is a public responsibility and a public burden. The failure to bring about this recognition constitutes the greatest arraignment against the activities of organized effort in our city.

Has not the time come when in all communities many of the shibboleths and texts which have guided our craft must be cast adrift and our course changed in accordance with the truths revealed by modern phthisiogenesis? Should not much of the obsolete literature which has been so prominent in our propaganda give way to an enlightened educational program which will spread the gospel of prevention of tuberculous disease rather than the danger of tuberculous infection? Can we go on consistently and intelligently making direct warfare on the tubercle bacillus while admitting the universality of tuberculous infection?

When an enlightened public opinion fully recognizes that it is as important to teach their children how to preserve their lives as it is to prepare them for the duties of life; when the hysterical fear of infection has been replaced by universal demand for cleaner, better and more wholesome living; when all the social agencies working for the betterment of mankind have correlated their activities and have recognized the truth that the tuberculosis problem is but a part of the public health program; then will the control of tuberculosis bid fair to become realized.

These, I take it, are the problems for the antituberculosis workers of the future.

THE PREVENTION OF TUBERCULOSIS[1]

WHAT WE SHOULD TEACH TO-DAY

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The more recent investigations as to the methods by which tuberculosis is transmitted from one person to another have demonstrated that certain newer measures are necessary for the prevention and eradication of this disease. Much that has previously been taught must, in the light of later research, and more widespread observation, be discarded. Prophylactic measures in vogue which do not harmonize with the more accurate knowledge of to-day must either be altered or abandoned.

Heretofore, the chief concern has been to educate, supervise and control adult cases of tuberculosis. It can now be demonstrated that these are in a measure the least important part of the problem. Infancy and childhood, previously practically neglected, constitute that part of the problem which should be our greatest concern.

The subject will therefore be discussed as it relates (1) to infants under three years of age, (2) to children over three years of age, and (3) to adults.

INFANCY

Careful investigations lead us to believe (1) that a child at birth is free from tuberculosis, even if one or both parents should be tuberculous at either the time of its conception or at the time of its birth; (2) that the great majority of adults who have tuberculosis, did not contract it in adult life, but were infected at some time in early childhood; (3) that, as regards infection, in children under three years of age the proportion infected is small, not because these are less susceptible but because they are usually less exposed, but that at this age, however, infection more frequently results in disease, and disease in children under three years is more often fatal than in older children; and (4) that in children over three years the proportion of those infected gradu-

[1] Presented at the Annual Meeting of the Canadian Association for the Prevention of Tuberculosis, Ottawa, Canada, October 19, 1919.

ally increases until at fifteen years it reaches about 90 per cent. After three years of age the type of disease is less severe; the period of sickness is usually more prolonged but deaths are less frequent although the number of cases is greater.

These observed facts clearly teach us that the logical method of attack on tuberculosis is to prevent disease, resulting from infection, in the young. The infant from the moment of birth until three years of age must be protected from infection by the tubercle bacillus. In the home in which there is a tuberculous parent drastic measures will be required. To compromise is but to invite disaster, with the assurance that the invitation will be accepted.

A tuberculous mother must not be allowed to come in contact with her child during this period. It is not sufficient to say that the mother must not nurse the child. For while it is admitted that few infants that have been nursed by a tuberculous mother survive, the danger from contact is not greater in nursing than in many other acts. Weinberg (1), in an investigation of 18,000 children, embracing 5000 families, found that the nearer the birth of the children to the time of the death of their tuberculous parents the higher the mortality among them. Fishberg (2) has shown that in New York City, among children of tuberculous parents, not only was the mortality in general excessive but that 16 per cent of the deaths among children under six years of age were due to tuberculous meningitis, as compared with only 1.27 per cent among the general population of the city. The conclusions are self evident, namely, that if the mother is tuberculous the infant should be removed immediately after birth, and that contact between mother and child should be prohibited during the first three years of life. *If the father is tuberculous he should not live in the house so long as there is in the house an infant under three years of age.* This point needs further emphasis. It does not make any difference how well trained the tuberculous person is or how much care is exercised, he or she should not live in the same house with an infant. No care which even the most careful consumptive may take will, as a rule, prevent infection in an infant if there is contact. And infection in infancy is almost sure to be followed by disease and disease is too deadly, in the majority of cases, to justify any risk being taken.

It is a matter of interest that our agriculturalists have long since recognized this fact, and have put it into practice to a very large extent. There is not an intelligent farmer who does not recognize that the

question as to whether or not the offspring of tuberculous animals become tuberculous depends entirely upon exposure after birth. With our domestic animals, where the value is recorded in dollars and cents only, we are willing to apply the knowledge we have and are securing self evident results. Are we to be less intelligent when we deal with the offspring of the human race?

So much for the infant in the home where there is tuberculosis. But what of the home in which there is no tuberculous person? The same general principles apply. The infant must be protected from the tubercle bacillus. The infant should be kept from contact with strangers. These strangers or friends may or may not be safe. Why take the risk? It used to be said that "Children should be seen and not heard," and, while this may still be true of older children, for infants it would be much better to reverse the advice and say that, in their own interest, "Children should be heard and not seen." Nor must the danger from grandparents, uncles, aunts, nurses, and domestics be forgotten. Any of these may be the source of infection unless they are known to be absolutely healthy.

The healthy parents should be impressed with the fact that infants under three years of age contract tuberculosis very easily, that a single exposure is frequently in itself sufficient, and that, on the other hand, by taking reasonable and ordinary care their children may be protected during this most susceptible period of life.

It should be added that the danger from bovine tuberculosis is not to be forgotten. When cow's milk must be used care should be taken to have it carefully selected and then pasteurized.

There is really nothing in the programme outlined above that cannot be done by any family of reasonable means. In other cases it would be an economy for the state to spend sufficient money to give this degree of protection to the infant population.

IN CHILDREN OVER THREE YEARS OF AGE

After three years of age when the child begins to run about, the problem becomes entirely different. Obviously it is not longer possible to secure the same degree of isolation as in the years of infancy. Nor is it desirable that this should be done. Now the child must be carefully introduced to the tubercle bacillus so that he may prepare his defense against it. As the child must soon go out into the world,

and there mingle with strangers of all kinds, it is obvious that he will at some time meet with the tubercle bacilli and become infected. We know that this will occur because we have evidence to the effect that at fifteen years of age about 80 or 90 per cent of children have been already infected. We know too that immunity is developed by repeated small doses, and that disease is produced by massive doses of infection. What we should aim to do then is to protect the child from massive infections such as might be had from tuberculous persons living in the house. These children are not likely to receive massive doses from strangers. If these massive infections are prevented we need not fear the smaller and more casual infections, because, except in the case of infants, these casual and small infections are relatively harmless. And as immunity is essential for the future welfare of the child it is quite desirable that it should be developed, and the period intervening between infancy and adolescence is the most opportune time at which to invite infection for this purpose. But while these small infections are being received and immunity developed it is most important and desirable that conditions should be such that the fruit resulting from the infection will be immunity and not disease. There must be no defective nutrition resulting from underfeeding, over work, or intercurrent disease. Resistance must not be reduced but must be maintained to as high a degree as possible.

IN ADULTS

In adults the problem of preventing infection requires very little attention. The great majority of adults have already been infected before reaching adult life. What adults have to fear most is not further infection from without, but an extension of the infection which they already have, leading to the development of a group of symptoms which we are pleased to call the disease tuberculosis. All adults should of course avoid prolonged and intimate contact with the grossly careless tuberculous person; but there is little to be feared through ordinary contact. It has been said that "the careful consumptive is not a danger to anyone." This might be modified to read "the consumptive is a grave menace to infants, less dangerous to children, and no danger at all to adults if reasonable care be exercised."

Tuberculosis in adults is either primary or secondary. If it results from a primary infection it runs an acute course and is almost

invariably fatal. This is the type of disease seen in primitive peoples, who have not been exposed to infection during childhood. The usual form of disease, however, as we see it in adults, is of the secondary type. This as a rule results from infection in childhood and is the type that produces the greatest portion of the tuberculosis problem. To avoid this type of disease the adult should not be taught to avoid other adults who happen to have the disease but who are not careless, but he should be taught to build up his defenses against the germs already in him. His resisting powers must be kept to a high degree of efficiency. Overwork, underfeeding, poor housing conditions, dissipation, and other disease are the things he should be taught to avoid; and rest, sleep, good food, fresh air, and moderate, temperate, healthful living are the things which he should be taught to seek.

Were this view of the prophylaxis of tuberculosis generally appreciated there would be a considerable change in the usual program of antituberculosis societies and boards of health. At the present time a great deal of attention is being paid to the adult with tuberculosis in institutions, in homes, and in places of business. Once an adult is labeled tuberculous he is at once shunned by his fellow adults, and in many municipalities becomes a subject of much attention on the part of health boards and well meaning social workers. Usually much of their effort is misdirected and instead of making the adult consumptive safe for the community he is made an unhappy subject of aversion to such a degree that he may be driven to adopt various methods of concealing the fact that he has the disease in order that he may be free from annoying and misdirected supervision. He thus becomes a greater menace than he was before. As Fishberg (3) concisely says:

> It is therefore a vain effort to follow up tuberculous persons, push them from pillar to post, interfere with their employment, as has been done in many cases with a view of preventing infection of fellow workmen.

Or as Baldwin (4) says:

> Adults are very little endangered by close contact with open tuberculosis, and not at all in ordinary association. . . . . It is time for a reaction against the extreme ideas of infection now prevailing. There has been too much read into the popular literature of health boards and lectures that has no sound basis in facts and it needs to be dropped out and revised.

Neither of these writers are disbelievers in the value of *all* of our present methods of prophylaxis against tuberculosis in adults. Nor do I wish to be misunderstood. Much that has been done is of great value. Many of the regulations we now have are excellent and deserve only more complete enforcement. But in spite of this there is much misdirected effort and much wasted energy on the part of inexperienced and poorly informed workers.

Let me emphasize again. We should not be afraid of the tubercle bacillus. For ourselves as adults, as a rule we need fear no attack except from those that are now in our bodies. For the children, since we cannot permanently protect them from invasion, let us wisely choose the time when the bacilli are first to be met. If this be done, the tubercle bacilli may be transformed from a menacing enemy into a protecting friend. This is what should be taught to every adult, as comprising the knowledge in accordance with which he should live and act as an individual.

Collectively, however, there is also something to be done in helping those who are but feebly able to help themselves.

There are but two real problems of importance, as I see it, aside from that of preventing the infection of children. These are (1) the best method of giving assistance to those tuberculous persons who are anxious to do all they can to live so as not to be a source of danger to others; and (2) the best method of dealing with those tuberculous persons who are careless of the rights of others and who have no concern as to whether they are a danger to others or not.

As to the first class, the greatest need usually existing is financial assistance. The only method, at present in use in Canada, by which a person with tuberculosis can obtain assistance is by entering a hospital or sanatorium. This method is open to but a comparatively small number. Let us get the situation clearly in mind. In the Province of Ontario there are perhaps 25,000 consumptives. These are not all indigent. Some are self maintaining, and some are only partially indigent. Suppose they are equally divided, about 8000 in each class. What can we do for them? It is evident that they cannot all be sent to institutions, because there are not more than 2500 beds for consumptives in the whole province. Fortunately it is not thought best that all tuberculous persons should be cared for in institutions. It is not desirable that they should be. You may reasonably ask what cases should be cared for in institutions.

There are three kinds of cases which should go to institutions: (1) Those who have no homes. These are the people living in boarding houses or rooming houses. (2) Those who have homes, but homes in which the conditions are so bad, from a social point of view, that one could not expect to have any success in enforcing any standard method of care. (3) All those who are palpably in need of education and who cannot be educated at home. For the sake of economy none of these should be sent to institutions in the haphazard way at present in vogue. A period of sanatorium treatment should be regarded as a serious undertaking, entailing expense to either the individual or the community and commensurate returns should be expected and sought. To this end those who should go to an institution at all should go for a definite period.

Early cases should go on the understanding that they stay three months at least: advanced cases, six months at least, with no option of coming out at all for any but the most serious reasons during that period. At the end of the period each case might be considered by a Board of Physicians, one representing the institution, and one representing that portion of the community which is supplying the funds for the maintenance of the patient, and one representing the patient. This Board should decide at the end of the stipulated period whether the patient is to stay longer or whether he may be allowed to go home to live under conditions that may be prescribed. Utilized in this way the 2500 beds available in Ontario would produce better results for the community than are secured by the methods at present in vogue.

And what of the 22,000 who must be cared for at home? We have developed a highly specialized and technical method of examining cases of tuberculosis and it would be just as simple to establish and to put into effect a standard method of treating cases of tuberculosis in the homes. The only real difficulty is that many have not the means. They need financial assistance and it would be economy to provide assistance so that home life under proper conditions could be maintained. This financial problem is not logically, as it has heretofore been regarded, a purely local one. The Federal and Provincial Governments are interested and should unite with the local municipalities to provide a fund for this purpose.

Now the last problem, that of the incorrigible consumptive, concerns the man (or the woman) who will not accept advice, who does not care whether he endangers the health, happiness or life of others or not, who

will not live under sanitary restrictions at home, and who refuses to be amenable to the rules and regulations of an institution. There is only one way to deal with such. They must be made to obey. They should not be allowed to remain a menace to the children in their own homes or to those of the neighborhood. Nor is it fair that they should be sent to institutions to disturb patients who are honestly endeavoring to help themselves by observing the necessary restrictions prescribed. These social and sanitary outlaws should be cared for in a tuberculosis department in a penal institution. I am satisfied that such a department would not need to be a large one. Let our hospitals and sanatoria be made as attractive as possible for voluntary patients, let assistance be given in the homes in suitable cases, let these advantages be offered alike to all who need them on condition that willing coöperation is forthcoming. But to those who will not coöperate let there be no option but a prolonged period in a place of detention. Moral suasion would then become a strong force in the hands of the social worker. In this aspect of prevention private philanthropy, municipal, provincial and federal officers of health are all interested. But the work of all of these should be so directed and coördinated that there may be no waste of effort in a campaign in which the attacking force is even under the best of circumstances anything but adequate. May it not be possible for us to hope that with the establishment of a Federal Department of Health and the appointment of a capable and energetic Deputy Minister, some such direction may be given to a widespread offensive against tuberculosis?

To this end education of the public is urgently required, and it would seem indeed to fall within the sphere of such an organization as this, in our present active period of reconstruction, to press for an active educational campaign along these lines:

1. The absolute protection of infants.
2. The careful protection of young children from disease, while immunity is being developed.
3. A more rational attitude toward, and treatment of, the adult consumptive.
4. The providing of maintenance assistance to needy consumptives, not only in institutions, but also at home, when prescribed living conditions are followed.
5. The detention of the incorrigibles where they will be neither a danger to children, nor an annoyance to their fellow adults.

REFERENCES

(1) Weinberg: Die Kinder der Tuberkulösen, Leipzig, 1913, cited by Fishberg, Pulmonary Tuberculosis, Lea & Febiger, Phila. & New York, p. 447.
(2) Fishberg, M.: Arch. Ped., 1914, xxxi, 96, 197.
(3) Fishberg, M.: Pulmonary Tuberculosis, p. 4521.
(4) Baldwin, E. R.: Bull. Johns Hopkins Hosp., 1913, xxiv, 220.

AN EXPERIMENT IN SANITARY EDUCATION

H. R. M. LANDIS

From the Henry Phipps Institute, Philadelphia

The following brief account relates to a small experiment in sanitary education which was carried out by the Phipps Institute several years ago. It also has its place in pointing out one way toward the control of tuberculosis.

The salutary effects of a police force are admitted by all. It takes no great stretch of the imagination to picture the probable result in any city from which such a force was entirely removed. It is scarcely to be doubted that there would almost instantly take place an enormous increase in all sorts of crimes, both minor and major. Organized society has always, from primitive times, held the right to exercise this authority. The protection of life through the exercise of police power is, therefore, a long established practice in so far as violence is concerned.

The protection of life from dangerous diseases is relatively a modern innovation and is concerned, largely, with those affections capable of producing and spreading epidemics. Until comparatively recently very little has been done, however, in regard to the protection of people against conditions which gradually undermine the health and ultimately lead to some serious malady. More and more, however, the necessity of taking cognizance of certain unhygienic evils is becoming the subject of legislation. Among the notable advances in this direction have been the improvement of factories and other places of employment and the gradual improvement which is taking place in housing conditions. It is with the latter phase of the problem that this experiment deals.

It is assumed by many that housing evils can be removed and slums abolished by the destruction or remodeling of unsuitable dwellings. It is taken for granted that people will live properly if you give them proper places to live in. This, however, is only partially true. Ignorance or the wilful disregard of hygienic laws is not overcome by the providing of so called "model houses." For instance, in a study of housing and living habits made by the Phipps Institute, it was found that in many cases the house was beyond reproach but that the hygienic habits of

the tenant were indescribably bad; and, conversely, houses were found which contained nearly every undesirable quality and yet the living habits of the people were beyond reproach. There are therefore two sides to this question which is to be partially solved by legislative enactments that aim to provide suitable living places, and partially by education which will inculcate into people the necessity of observing hygienic laws. And even education is not entirely sufficient for the correction of the second evil. There must be in addition the exercise of police authority, not arbitrarily used but with discretionary powers to enforce the law when instruction and persuasion have proved unavailing. This is particularly true of our foreign population. A very large proportion of these people is densely ignorant of hygiene, and even when provided with modern conveniences, they have no adequate idea as to their proper uses.

Having in mind the difficulties as outlined above, the Phipps Institute leased, in 1913, a small group of houses, selecting for this purpose a type of property which is looked upon as the worst in the city. In Philadelphia there have been built, in times past, what are known as "court" houses. As a rule, they have been erected in the rear of houses which formerly had large back yards. They are usually reached by a narrow passage-way and may consist of one row of houses facing a narrow space; or both sides may be built up with a narrow space between them. In many instances these "courts" are undesirable to the last degree; in others, they are susceptible of such improvement as to warrant their use.

Feeling that many of these places present a bad appearance, as much by reason of the utter disregard of the tenant to hygienic laws as anything else, we selected a "court" consisting of five houses, in a congested portion of the city.

Figure 1 shows very well the appearance of this "court" when we took it over. Dividing the space in front of the houses was a series of high board fences alloting to each its small yard. These yards had served as the dumping ground for the respective tenants and in several of them garbage and other refuse had accumulated to a depth of four or five feet. There was one hydrant for the five houses and no running water in the houses. A large privy vault in one corner served for all the families; and, when this was emptied prior to its destruction, several hundred barrels of material were removed. It probably had not been cleaned for years. Through the generosity of Mr. Henry Phipps and

several others, a thousand dollars were obtained to make the necessary improvements. The fences were removed and the entire yard thoroughly cleaned. An additional hydrant was installed and running water placed in the first floor of each house. Gas lights were provided for in the first and second floors. At the time of our taking the houses over it was found impossible to open a single window. This defect was remedied so that free ventilation was provided for. The privy vault was

Fig. 1. The Court at the Time the Experiment was Begun

abolished and a water closet was installed for each family. The houses themselves were cleaned and repapered. Window boxes were placed before the windows of the first floor of each house and flowers were planted along the wall opposite the houses. It was predicted by many that this innovation would meet with failure as the children would most certainly destroy the flowers and plants: but, on the contrary, the children, even more than the adults, took great pride in the flowers and

tended them faithfully. A sand company donated a load of sand each spring to furnish a small playground for the children. In this connection it may be stated that at one time the houses contained no less than fifteen children under ten years of age. In spite of the fact that there was nothing to prevent them, in common with the other children of the neighborhood, from seeking their amusements in the street outside the court, they rarely left it.

FIG. 2. THE SAME COURT AFTER RENOVATION

Figure 2 shows the "court" in its renovated state. Granting that the picture taken in its original condition was at a different season of the year it must be admitted that the improvement, in attractiveness and cleanliness was noteworthy. So much for the physical side of the problem.

The tenants installed in these houses were families who had attended the dispensary of the Institute and were all foreign born. A nurse was put in charge of the educational work. The people, in spite of the im-

proved living conditions in which they found themselves, displayed at the very outset of their occupancy the traits which characterized their former living habits. Garbage and refuse were as often as not thrown out of the front door instead of being deposited in the garbage can placed behind a latticed screen in one corner of the yard. Various other degrees of slovenliness were exhibited in the housekeeping habits of the women. The water closets were quite constantly badly kept and the seats soiled. In the beginning considerable trouble was experienced; partly, by reason of the habits of the people, and partly, because of incompatibility. As the families were brought into closer intimacy with each other, it seemed almost impossible to reconcile their various differences. One woman, for example, had such a shrewish nature that she constantly quarreled with everyone. In another instance the morals of one of the tenants did not seem to be what they should have been. Gradually, however, these undesirables were weeded out and others substituted for them. Originally all of the families were Russian Jews. A distinct change for the better occurred when two Italian families were installed.

The nurse made a daily visit, inspected everything about the premises, and explained the necessity of cleanliness both inside and outside the house. If after a fair trial the individual persisted in breaking the rules he was threatened with eviction if the offence recurred. It is but natural to expect that the receptiveness of the people varied: some grasped the situation very quickly; others responded much less readily. Daily visits, taking about an hour each, were required for about four months. The nurse then went to the "court" two or three times a week and finally but once a week. After the crucial period of education had passed but few infractions of the rules occurred.

In regard to the cost of the improvements it was amply demonstrated that the rent could be advanced to a rate commensurate with this outlay and without objection on the part of prospective tenants. The most interesting part of the experiment and the reason which primarily led us to undertake it were (1) the fact that, left to themselves, people are not likely to improve their habits even if given conditions superior to those to which they have been accustomed; and (2) the fact that relatively little instruction and supervision are needed to correct these bad habits. The experiment was carried on for three years. We had the feeling that after the lapse of but a short time conditions would revert to their former state when our supervision ceased. To our sur-

prise this has occurred to a much slighter degree than was expected and even then has manifested itself largely in the absence of the aesthetic effect rather than a reversion to faulty hygiene (see fig. 3). This has been due to the fact that the families who occupied the houses under our regime continued afterwards.

It must be admitted that this experiment was a small one. On the other hand, it should not be a difficult matter to enlarge its scope. The

FIG. 3. THE COURT SEVERAL YEARS AFTER SUPERVISION HAD CEASED

amount of time given by the nurse was trivial, even in the beginning. Furthermore, once the preliminary stage of education has passed, the number of people who could be supervised by one nurse would be very considerable. It follows, as a matter of course, that the amount of supervision needed would vary greatly in different parts of the city. In some districts relatively little would be needed; in others, where the population is congested and made up of the poorer and ignorant elements, the supervision would have to be more intensive.

The difficult problem is to determine how this supervision should be carried out. Should it be by the municipal government alone or by the different private agencies now at work? In addition, how should the laws be enforced? There can be but little doubt, I think, that in all matters relating to the public health, the Municipal Board of Health should be the directing force. This is obvious (1) because of the expense and (2) because of the need of adequate authority to enforce the laws. There is no reason, however, why the personnel of existing agencies should not be utilized.

It goes without saying that politics must of necessity be eliminated and that it should be made impossible for any one to invoke "influence" to escape his misdeeds. This phase of the subject has been commented on so frequently in regard to all public health matters that it need not be enlarged upon.

The essential factor, to my mind, is that the dominant feature should be the educational side. The enforcing of penalties is, of course, inevitable in a certain proportion of cases but it should be the aim of the workers to exact these as seldom as possible. Certainly an arbitrary power has no place in such work. It is to be borne in mind that all reforms are brought about gradually and that success in work of this kind requires tact, patience, and the enforcing of penalties only when absolutely needed.

THE TUBERCULOSIS CLINICS OF NEW YORK CITY[1]

The method pursued in the study of tuberculosis clinics, like that of the venereal disease clinics has been somewhat more intensive than in the study of the other branches of the dispensary.

The medical histories of the tuberculosis clinics, being superior to those of other departments in fulness of statement, have lent themselves to the preparation of a considerable number of statistical analyses.

In the preparation of these analyses the material available in the annual reports of the Association of Tuberculosis Clinics has been utilized in addition to the detailed information obtained from 200 individual case records. Twenty records were obtained from each of the ten clinics of the city outside of those operated by the Department of Health. The basis for the selection of the 200 records was as follows: in each instance 10 cases were selected originating several years prior to the war, 5 were taken from the 1917 files, and 5 cases which closed in 1918 irrespective of when they first became known to the clinic.

The selection of cases was made with the purpose of arranging the information gleaned into two or three series which would contribute to the gauging of the effectiveness of the existing administrative procedure and organization and the ultimate results of clinic supervision, and which would bring out the differences, if any, in procedure in the war period as compared with the preceding years.

Of the 200 cases thus selected, 77 have been under care for less than two years, 50 from two to three years and 73 for more than three years (table 2).

When interpreting the findings it must be borne in mind that in view of the small number of cases on which the study is based they are not more than indicative of certain tendencies of tuberculosis clinic work. The whole study is merely suggestive and affords more of a groundwork for a thoroughgoing analysis than a basis for any sweeping deductions. Furthermore, being limited to a group of selected cases which have been under continued care and have coöperated with the clinic, the

[1] This constitutes a part of a *Report on the Study of Dispensaries in New York City*, by the Public Health Committee of the New York Academy of Medicine.

picture presented by the figures does not represent the work of the clinic with the average run of patients. That type of work is better illustrated by the figures obtained from the annual reports of the Association of Tuberculosis Clinics, where account is taken of all cases which present themselves at the tuberculosis clinics of this city.

While the tuberculosis study, as the other medical studies in this report, is based chiefly on the records, an account has also been taken of the organization of the clinics, the hours at which they are opened, the number of clinics held weekly, the laboratory facilities, the nursing personnel, the use of educational literature and the problems of the medical social workers in connection with the tuberculosis cases.

1. STUDY OF 200 INDIVIDUAL RECORDS

1. Nationality, age, and sex of patients. Of the 200 cases under survey, 7 were children under sixteen, and 43 persons over forty-five years of age. The great bulk of the patients was between the ages of sixteen and forty-five. Eighty-two of the total number of adults were males and 111 were females. The national or racial groupings were as follows: native born, 62; Italians, 27; Hebrews, 56; Irish, 26; Slavs, 6; Germans, 4; negroes, 3; and miscellaneous, 16. The largest numbers of the native born patients were found in Vanderbilt Clinic, St. Luke's, Lenox Hill and New York Hospital: 44.5 per cent of the Italians were in the New York Dispensary and 22.2 per cent at Bellevue. Over one-third of the Hebrew patients were at Mt. Sinai and another third at Gouverneur. (Distribution of the patients by age, sex and nationality among ten institutions is given in tables 1A and 1B.)

The character of occupation was stated in all but the seven cases of minors; and of the 193 adults, 74 were housewives or domestics, 19 factory operators, 12 janitors or cleaners, 8 students, 6 each laborers, cigarmakers, elevator operators and clerks, 5 laundresses, 4 each dressmakers, tailors and peddlers. The rest were scattered among various occupations.

The statistics of the economic status of these patients was not indicated accurately enough from the records to allow of an adequate tabular presentation.

2. Source of reference. Forty-one cases came to the tuberculosis clinics referred by the agents of the Department of Health. This figure includes cases referred from the Department of Health Tuberculosis

Clinics. Private physicians referred 40 cases; 36 cases came from other departments in the dispensaries; and 18 were sent by the Relief Societies, of which 12 were referred by the Association for the Improvement of the Condition of the Poor; 17 were transfer cases from other tuberculosis clinics; and the rest came in through the efforts of the clinic nurse or at own initiative. For 12 cases no information is given as to source of reference.

An attempt was made to ascertain the duration of illness prior to the patient's first visit to the tuberculosis clinic for treatment but the information recorded was of so indefinite a nature that it was impossible to make a satisfactory classification with regard to this point.

3. *Medical histories.* According to the records of the 200 cases, 98 per cent of the patients received a chest examination and in 99 per cent of the cases weight, respiration, pulse and temperature were taken. In addition, the records indicate (table 5) that abdominal examinations were made in over 8 per cent of the cases, teeth were examined in 15 per cent and in only 6 per cent of the cases were throat examinations made. Blood pressure was recorded as having been taken in over 7 per cent of the cases, laboratory tests were recorded in 98 per cent of the cases, sputum examinations were made in over 92 per cent of the cases, X-ray investigation in 34 per cent, fluoroscopic examination in 2.5 per cent, urinalysis in 40 per cent, and the Wassermann test in 11 per cent. The medical records also contain a great deal of detailed information about the patients as can be seen from table 3. The habits of the patients as to bowels, sleep, appetite, etc., were recorded in 96.5 per cent of the cases, and as to alcohol, tea, coffee and tobacco in 70 per cent; family history in 91 per cent, personal history in 79 per cent, home condition in 77 per cent, occupation in 96 per cent, medication was indicated on 94 per cent of the records and re-visits noted in every instance. A social service history was recorded in 86 per cent of the cases and home visits made in 81 per cent. The progress of the patients was indicated in 71 per cent of the records.

4. *Attendance of patients.* The attendance of patients in the several institutions has been tabulated by the length of time the patient was registered at the clinic. In only two institutions did we find patients who had made less than five visits; and, in both instances, the patients were in a group of cases registered at the clinic between one and two years. Fifteen different patients registered in eight clinics had each

made more than one hundred visits. Thirteen of these were in a group registered from three to four years or longer.

For the 77 cases who have been attending the clinic between one and two years the median number of visits was 16, the median number of visits made by the 50 patients who are coming to the dispensary between two and three years was 30, and 48 visits was the median number for the group of 73 patients who are connected with the clinic for over three years (table 2).

Bellevue, Harlem Hospital and New York Dispensary are the three institutions where frequency in attendance of patients is above the general median in each of the three groups. Lenox Hill, Gouverneur, New York Hospital and the Presbyterian come above the respective medians in two groups and below in one of the groups, while the remaining institutions show a higher attendance distribution in one group and lower than the general median in two groups.

In order to determine if there might be a correlation between attendance and frequency of physical examinations or of sputum analyses, the available information has been tabulated, and it can readily be seen that no such correlation exists. Although at the New York Dispensary, for example, a physical examination is given on the average of every eleventh visit and the sputum examined on the average of every nineteenth visit, the attendance, on the basis of this limited study, is greater than at St. Luke's where the patient receives a physical examination on every third visit and his sputum is examined on the average of every fifth visit.

INSTITUTION ACCORDING TO AVERAGE ATTENDANCE OF PATIENTS	PHYSICAL EXAMINATION MADE ON THE AVERAGE OF EVERY	SPUTUM EXAMINATION MADE ON THE AVERAGE OF EVERY
Highest:		
Bellevue	3rd visit	11th visit
Harlem	7th visit	9th visit
New York Dispensary	11th visit	19th visit
Second group:		
Lenox Hill	14th visit	19th visit
New York Hospital	9th visit	11th visit
Gouverneur	3rd visit	6th visit
Presbyterian	4th visit	7th visit
Third group:		
Vanderbilt	5th visit	11th visit
St. Luke's	3rd visit	5th visit
Mt. Sinai	5th visit	7th visit

When the average attendance of patients by clinics is studied on the basis of annual figures, the order is quite different from what it is in the above table. Gouverneur and St. Luke's are at the head of the list. In view of the fact, however, that no adequate figures are available for the number of physical examinations and laboratory tests made during a year at each of the tuberculosis clinics, averages for these procedures cannot be figured and the existence or lack of correlation established.

In another part of the report the direct relation between nurses' visits to the homes of the patients and clinic attendance is clearly discernible.

5. Reasons for terminating cases. Of the 200 cases, 61 were terminated at the time the records were copied and 129 were still open. An analysis was made of the reasons for closing cases. Non-attendance was given as the reason for the termination of 9 of them; death of 4; sanatorium care for 4; hospital care for 3; removal from the district for 10. In 28 instances the case was "arrested" and in 3 instances the patient returned to the care of private physicians.

6. Distribution of patients to sanatoria and hospitals. Of the 200 cases 84 had no change of environment and for the remaining 116 such change had been procured. The following are the hospital or other opportunities taken advantage of by the patients.

Otisville	23	New York State Sanatorium	13
Sea View	20	Day Camps	31
St. Joseph's	4	Home Hospital	6
Seton	11	Montefiore Home	4
Metropolitan Hospital	7	Country Place	22
Bedford	14	Unspecified	47

Some of the patients are listed under more than one heading, having gone to more than one institution during the period under supervision. The different clinics make use of the existing opportunities in varying degrees. Some direct larger proportions of their patients to certain institutions than others. The clinics vary also as to efficiency in arranging the needed change of environment. Gouverneur had 15 of its 20 patients placed; Bellevue and Mt. Sinai 14 each; St. Luke's and Vanderbilt 13 each; Presbyterian and the New York Dispensary 10 each; Harlem, New York Hospital and Lenox Hill 9 each; for its fifteen patients Gouverneur arranged 29 accommodations, that is, almost every patient received two opportunities for change of environment. The same applies to Bellevue and Mt. Sinai (table 4).

In order to throw additional light on the efficiency of the clinic, a study was made of the time elapsing between the advice given by the doctor as to the need for a change in environment and the departure of the patient. In only a limited number of institutions was it feasible to obtain the information, as on many of the records the date of the doctor's advice is not given, and moreover, the delay is frequently not the fault of the social service workers, because of the difficulties that are sometimes encountered in getting a patient into an institution (that is, refusal of institutional treatment by the patient or refusal of the patient by the institution). All the patients referred to hospitals, however, were placed there within two weeks; the delay with reference to sanatoria is much more marked. Of the 35 placed in sanatoria, for which definite information is obtainable, only 3 succeeded in getting away within two weeks, 12 between two weeks and a month, 15 between one and two months and 5 between two and four months. For the 31 cases which went to day camps all the preliminaries were arranged in two weeks.

7. *Supervision.* The work of the tuberculosis clinic in the prevention of disease can be judged by the proportion of the total number of persons belonging to the patients' families, who are induced to come to the clinic for a physical examination. Accordingly an attempt was made to elicit this information. In pursuing the analysis of the available material we found that of the possible number in the families, which might have been examined, Presbyterian recorded an examination of 51 per cent; Bellevue 47 per cent; St. Luke's 42 per cent; New York Dispensary 34 per cent; New York Hospital 33 per cent; Mt. Sinai 30 per cent, and Gouverneur and Harlem each 26 per cent. This information was not ascertained for Lenox Hill; and Vanderbilt's social service records were so incomplete that it was impossible to obtain the figures. In all, 246 persons in addition to the patients in the 200 families studied were recorded as having had a physical examination at the clinics with a view of discovering incipient tuberculosis or other preventable disease.

Of the members of the families examined (mostly children) the following proportions were sent to day camps, preventoria or for country vacations:

At the Presbyterian 22 per cent; New York Hospital 21 per cent; Bellevue 19 per cent; St. Luke's 17 per cent; Gouverneur 14 per cent; Mt. Sinai 11 per cent; New York Dispensary 6 per cent; and none at Harlem so far as the records indicate.

8. Relief. In the group of the 200 patients studied it was necessary to obtain relief in some form or another for 90 cases. In 24 instances the relief consisted of extra diet; in 12 instances it was clothing that was needed; and in 7 instances a money allowance was given. In 66 cases the family was referred to relief societies from which various forms of relief were obtained. The largest number of relief cases was recorded in the Presbyterian clinic where 18 cases were afforded relief in some way. Fifteen cases of dependents were recorded at Bellevue; 11 at St. Luke's; 8 each at Gouverneur, New York Dispensary, Vanderbilt, New York Hospital and Lenox Hill; 5 at Mt. Sinai; and 1 at Harlem. Extra diet was given to 6 cases each by St. Luke's and New York Hospital; 4 by Bellevue; 3 each by Mt. Sinai and Presbyterian; and 1 each by Gouverneur and Vanderbilt.

2. FACILITIES AND PROCEDURES

The following is a brief description of the administrative machinery and procedure obtaining in the tuberculosis clinics which have a bearing on the results discussed in the preceding part of the report.

1. Clinic hours. Of the ten clinics included in the study, four (Gouverneur, Harlem, Bellevue and Presbyterian) are open daily. Lenox Hill, New York Dispensary and New York Hospital are open four and Vanderbilt, St. Luke's and Mt. Sinai three days a week. All of the ten clinics have special sessions for children. Four of them (Harlem, New York Hospital, Bellevue and Presbyterian) have night clinics, the three former having one session per week, while the Presbyterian has two. The need for evening clinics was emphasized at each of these hospitals, as the patients who attend in the evening are usually "arrested" cases and are at work during the day. Bellevue has had an evening clinic for more than seven years. The average attendance is about ten patients, although there has been a drop in attendance during the war. Harlem's evening clinic has been in operation for four years and averages about 18 patients per session. There it is regarded as of equal importance with the day clinic. The Presbyterian finds it necessary to run two evening sessions, averaging about 12 patients at each session. The New York Hospital has a smaller clinic with a steady clientele. Many of the patients here have been under supervision in the evening clinics for years while continuing to work.

2. *Nursing service.* The number of nurses employed by the different clinics varies from one each at New York Hospital and New York Dispensary to 6 at Bellevue. Mt. Sinai employs 4 nurses, Harlem usually 4, although only 3 were employed during the period covered by this study, and Lenox Hill, St. Luke's and Gouverneur each 2. Presbyterian has 1 regular clinic nurse and also a pupil nurse who gives one-fourth of her time to the clinic. Vanderbilt employs three clinic nurses and the social service supervisor devotes part of her time to the department. At Bellevue 1 nurse acts as supervisor, while 1 is in charge of the ward work and transfer of cases. During and after the time the study was made, there occurred a certain amount of shifting of nurses at several of the hospitals because of the return of nurses from war work, etc.

By making use of the figures of the Association of Tuberculosis Clinics Reports for the first half of the year 1919, we are able to compare the number of cases under treatment at each clinic with the number of nurses employed and so estimate the average number of patients under each nurse's care. We are thus also able to ascertain the average number of nurse's visits to the patient.

INSTITUTION	NUMBER OF NURSES	NUMBER OF PATIENTS UNDER TREATMENT	AVERAGE NUMBER OF PATIENTS PER NURSE DURING FIRST HALF OF 1919	NUMBER OF NURSES' HOME VISITS FIRST HALF OF 1919	AVERAGE NUMBER OF NURSES' HOME VISITS PER PATIENT FIRST HALF OF 1919
St. Luke's	2	317	158	2110	6.6
Vanderbilt	3½	695	199	2462	3.5
Bellevue	6	1759	293	1573	0.8
Lenox Hill	2	611	305	1163	1.7
Gouverneur	2	620	310	1223	1.9
Mt. Sinai	4	1461	365	891	0.6
Harlem	3	1302	434	2573	1.9
New York Hospital	1	446	446	759	1.7
New York Dispensary	1	764	764	834	1.1
Presbyterian	1¼	1180	944	1381	1.2

The average number of patients per nurse does not of course indicate the number of patients under a nurse's care at any one time but is simply a computed average of the number of cases with which she came in contact in the first six months of 1919. According to these figures the nurses at the Presbyterian and New York Dispensary have a very much larger number of cases to care for than the nurses at the

other hospitals. It must be borne in mind, however, that the organization in different hospitals affects this figure. In hospitals employing several nurses 1 must devote part of her time to supervising the activities of the rest, and in many of the dispensaries nurses have special duties, for example the ward work at Bellevue, which makes it impossible to devote time to visiting.

It will be seen from the figures above that the average number of nurses' home visits per patient does not correspond in every case with the average number of patients under care by each nurse. Although St. Luke's and Vanderbilt with the lowest number of patients to handle record a correspondingly high number of nurses' visits to the homes, Presbyterian and New York Dispensary with the highest number of patients per nurse average a larger number of nurses' home visits than Bellevue or Mt. Sinai, which have a much smaller number of patients per nurse. One reason for this, as indicated before, is the organization of service. At both Bellevue and Mt. Sinai, the time of 1 nurse is given to supervision, while at New York Dispensary as only 1 nurse is employed, no time is taken for this purpose.

There is also a difference between the different hospitals in their procedure of recording visits, some recording only visits where the patients are seen, and others recording even telephone calls. The amount of clerical work done by the nurses also affects the number of visits possible; for example, Vanderbilt has a high average number of visits, but keeps rather inferior social service records. The use of volunteers at the different clinics who assist in clerical work will also be reflected in the amount of visiting done by the nurses. Presbyterian, St. Luke's and Lenox Hill have regular volunteers at their clinics and New York Hospital has a volunteer who helps at times.

3. The follow-up and supervision of homes. All the clinics profess practically the same standards with regard to following-up patients and supervising their homes although in actual operation their procedure varies according to the pressure of work to be done. Usually every new patient is visited in his home within a month of his registration at the clinics. This visit is for the purpose of studying the home conditions and giving instruction to the patient and his family and is repeated from time to time as the need of the case justifies. Patients who do not return to the clinic regularly are visited at their homes to ascertain the reason for non-attendance.

Records which correspond to social histories are kept in most cases and these records are usually filed with the patient's medical history, and are thus available to the doctor at all times.

In the 200 cases covered in our survey the social history was lacking in 10 cases from Vanderbilt, 7 each from New York Hospital and Mt. Sinai, 3 from New York Dispensary and 1 from Lenox Hill. The record of every other case studied contained a social service history.

As this part of the nurse's work combines social service with public health nursing, in many instances the nurse in the tuberculosis clinic is considered a social service worker and is under the direction of the social service department, although in addition to her social and public health work she is called upon to perform many nursing duties at the clinic sessions, such as weighing patients, taking pulse and temperature and collecting laboratory samples.

4. Laboratory facilities. Only one hospital, the Presbyterian, does all its own laboratory work, including sputum analysis. Gouverneur does its own urinalysis, sending the rest of the work to the laboratory of the Department of Health, while the Department of Health is called upon to do all the laboratory work for the Harlem Hospital. The other hospitals do locally all the laboratory work except the examination of sputum, which is done by the Department of Health.

In this connection it might be interesting to present the extent to which laboratory facilities were used in connection with the 200 cases under study (table 5). Examination of sputum was recorded for 20, or 100 per cent of the cases at Gouverneur, Harlem and New York Dispensary; for 19, or 95 per cent of the patients at St. Luke's, Mount Sinai, Presbyterian and Bellevue; for 18, or 90 per cent of those at Lenox Hill; for 17, or 85 per cent of those at New York Hospital; and for 14, or 70 per cent of those from Vanderbilt. The records show that a urinalysis was made in 16 or 80 per cent of the cases at Gouverneur and Presbyterian; in 13 or 65 per cent of the cases at Lenox Hill; 10 or 50 per cent at Vanderbilt; in 7 or 35 per cent at New York Hospital and Mt. Sinai; 5 or 20 per cent at Bellevue; 3 or 15 per cent at New York Dispensary; and 1 or 5 per cent at Harlem. The number of Wassermanns recorded among the 20 cases from each hospital were as follows: Presbyterian, 6; St. Luke's, 4; Vanderbilt, New York Hospital, Mt. Sinai, Lenox Hill, Gouverneur and Bellevue, each 2. There was no record of a Wassermann in the 20 cases studied at Harlem nor at New York Dispensary.

An X-ray examination was recorded for 17 or 85 per cent of the cases at Mt. Sinai; for 10 or 50 per cent at Gouverneur; for 9 or 45 per cent at New York Hospital and Presbyterian; for 8 or 40 per cent at St. Luke's; for 4 or 20 per cent at Harlem, Lenox Hill and Bellevue; and 3 or 15 per cent at Vanderbilt. No record was found of an X-ray examination in the 20 cases studied at New York Dispensary. Lenox Hill recorded 4 fluoroscopic examinations and New York Hospital 1.

5. *Instructions to patients.* The clinics were found to be fairly uniform as to the kind of personal instruction given to the patient. Emphasis is laid upon hygienic habits of living, and especially upon care of the sputum. This instruction is given both by the doctors in the clinic and the nurses in the home. The time given to this very important clinic activity depends largely upon the interest of the individual worker, and the pressure of work to be done.

6. *Educational literature.* At the time our worker visited the clinics only 7 were found to be distributing educational literature to the patients. At Vanderbilt, New York Hospital and Mt. Sinai, no literature was being given out. In the hospitals where literature was used the Department of Health material was distributed by all except Lenox Hill which prepared its own educational pamphlets.

7. *Relief giving.* All clinics, except New York Dispensary, Harlem and Lenox Hill, have special funds from which relief can be given. In most instances this fund is used largely for extra diet. In each of the dispensaries where no fund was available, the worker expressed a desire for such a fund.

3. THE DEVELOPMENT OF TUBERCULOSIS CLINIC WORK

The campaign against tuberculosis, which was the starting point of the modern public health movement, was responsible for the establishment of the tuberculosis clinic. In the City of New York the organization of the Association of Tuberculosis Clinics stimulated better and more uniform clinic organization. A study of the figures published in the annual reports of the Association throws interesting light on the growth and development of the tuberculosis clinics.

1. *Volume of work.* The table given below illustrates the increasing volume of work of the tuberculosis clinics since 1909. The number of patients treated more than doubled from the year 1909 to 1915 and since then there has been relatively little change, although during the

year 1918 there was a decrease of over 2,000 cases in comparison with the preceding year.

YEAR	NUMBER OF CASES TREATED	NUMBER OF VISITS TO CLINICS	AVERAGE NUMBER OF VISITS PER CASE
1909	21,811		
1910	30,399		
1911	32,058	117,718	3.7
1912	29,705	117,490	3.8
1913	38,815	170,467	4.3
1914	39,418	159,241	4.0
1915	45,862	185,487	4.0
1916	45,507	166,769	3.6
1917	46,266	152,773	3.3
1918	44,248	138,085	3.1

While the number of cases treated annually since 1915 remained practically the same, the number of visits made to the clinics decreased rapidly. There were probably several causes responsible for this decreased attendance but one chief reason was no doubt the falling off in the average number of nurses' visits to the homes of the patients.

2. *Relation of attendance of patients to nurses' home visits.* Neither the Department of Health nor the private clinics has always supplied the necessary number of nurses to enable them to do as much visiting as was necessary in the interests of proper home supervision and of maintaining the patient's attendance.

YEAR	TOTAL NUMBER OF NURSES' HOME VISITS	AVERAGE NUMBER OF HOME VISITS PER NURSE	AVERAGE ATTENDANCE OF PATIENTS AT CLINIC
1909	41,870	1.9	
1910	56,704	1.9	
1911	63,030	1.9	3.7
1912	105.002	3.5	3.8
1913	113,711	2.8	4.3
1914	98,221	2.4	4.0
1915	101,424	2.2	4.0
1916	83,599	1.8	3.6
1917	81,788	1.7	3.3
1918	61,296	1.3	3.1

The average number of nurses' visits to patients reached its highest point of 3.5 in 1912 and since that time it has been constantly declining, as has the average attendance of patients at the clinics. The highest attendance was recorded in 1913 following and during the year of the

greatest per capita number of home visits by nurses. There seems to be a very evident and direct relationship between the clinic attendance and the visiting of patients by nurses. As through the nurses' home visits two important things are accomplished, namely, the supervision of the home environment of the patient and his family and the increased amount of medical attention through better clinic attendance of patient, ampler nursing facilities at the clinics are strongly indicated.

3. *Treatment of children.* Early in the history of the Association of Tuberculosis Clinics especial emphasis was laid upon the supervision of children in the families of tuberculous individuals, and the clinics were urged to hold special sessions for children. At the present time most of the tuberculosis clinics have such special sessions for children and the results of this effort in the direction of preventive medicine are illustrated by the appended graphic chart.

In 1909 children constituted only 8.1 per cent of all the patients under clinic supervision. It was impossible to obtain the figures from which to compile the proportions in 1910 and 1911, but for the years 1912 to 1917 the percentages of children were as follows: 24.6, 25.3, 30, 34.9, 38 and 40, the year 1917 showing nearly 5 times as great a proportion of children under clinic supervision as in 1909. There was a slight diminution of this figure to 39.5 per cent in 1918. (See chart 1.)

4. *Proportion of cases discharged to institutions.* The increasing proportion of the so called "discontinued" tuberculosis clinic patients who are placed in institutions for treatment for the years 1909 to 1918 is a gratifying phenomenon.

YEAR	TOTAL NUMBER DISCONTINUED	TOTAL NUMBER TO INSTITUTIONS	PER CENT
1909	9818	1737	17.6
1910	13564	2103	15.1
1911	14779	2213	14.2
1912	13024	2449	18.1
1913	15213	3848	22.6
1914	15940	3698	23.1
1915	16485	3823	23.1
1916	16711	3722	22.1
1917	16150	3654	22.1
1918	14332	3049	21.1

This phenomenon may reflect either the increased efficiency of the clinics in their placing of cases or it may be due to the increased capacity of institutions, or to both of the factors in combination. The

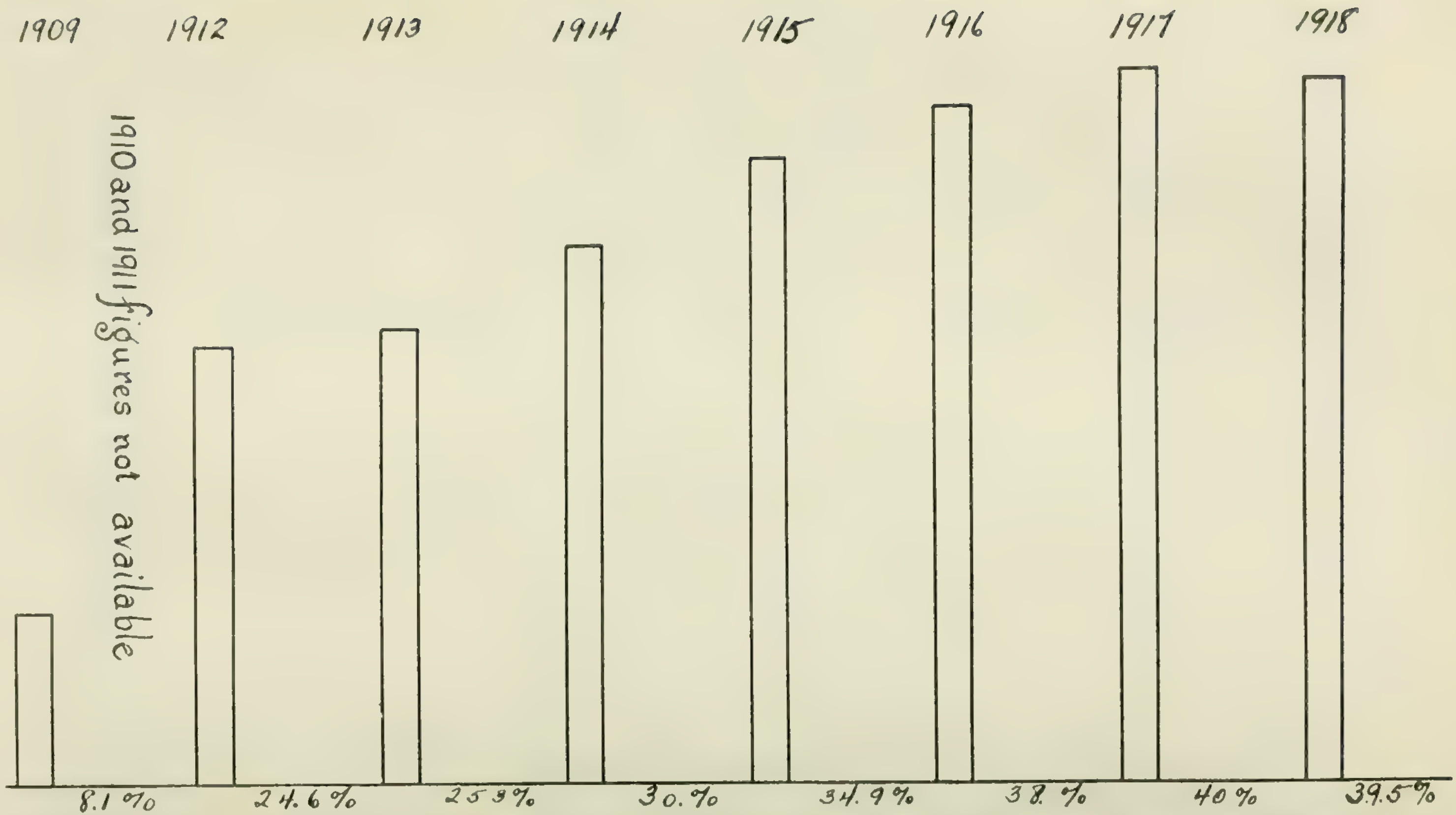

Chart 1. Showing the Proportion of Children among the Patients under the Supervision of the Tuberculosis Clinics

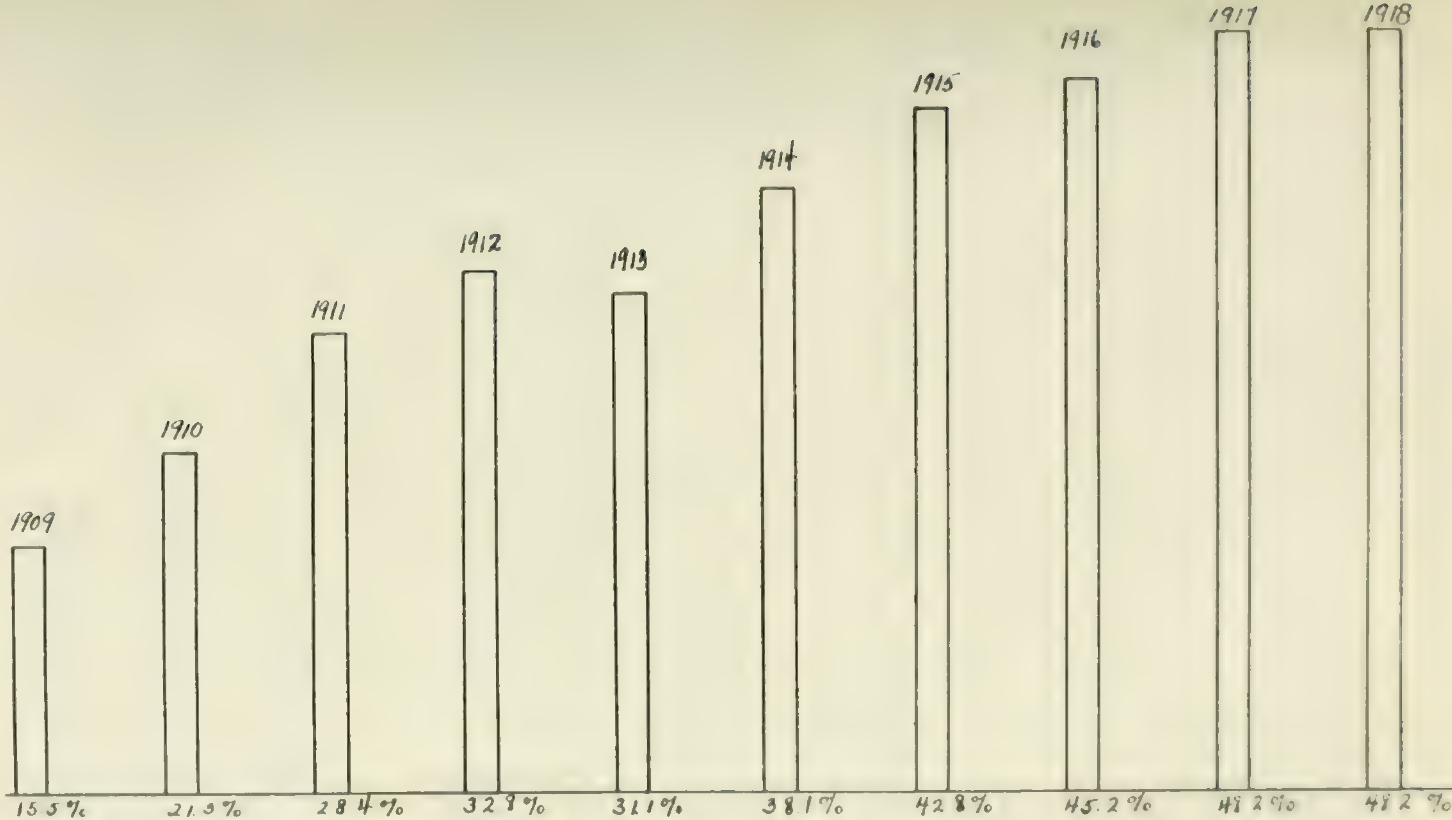

Chart 2. Showing the Proportion of Non-Tuberculous Cases Examined in the Tuberculosis Clinics

increase in 1913 and 1914 coincides with the opening of the Sea View Hospital and St. Anthony's in these years, and the decrease in 1918 is probably due to the disorganization during the war.

5. *The proportion of cases found non-tuberculous.* The increasing proportion of cases discharged from the clinics as "non-tuberculous" demonstrates the fact that more people are coming to the clinics for diagnostic purposes. The Association of Tuberculosis Clinics early in its history insisted upon the importance of medical supervision of the families of patients, and these figures would seem to indicate the successful working out of this plan.

The attached graphic chart illustrates the gradual increase in the proportion of cases discharged from the clinics as "non-tuberculous" during the years from 1909 to 1918. This proportion has increased steadily and more than tripled in the ten years during which the clinics have attempted to bring in for examination all the members of the families of their patients. (See chart 2.)

4. COMPARISON OF TUBERCULOSIS CLINICS WITH OTHER DEPARTMENTS

Although the tuberculosis clinics vary among themselves as to the degree of their efficiency, they are, as a group, superior in organization and procedure to the other departments of the dispensaries as the following comparison clearly demonstrates. In drawing inferences from the comparisons, it must be borne in mind, however, that the selection of records from the tuberculosis clinics may give them a certain degree of advantage over the other dispensaries, in that all of the tuberculosis records referred to cases of more than one year's association with the clinics, while not all cases in the other clinics were of similar duration.

COMPARISON WITH GENERAL MEDICAL CLINICS

1. *Content of medical history.* The diagnosed records, studied from the general medical departments, indicate the habits of the patient as to alcohol, tea, coffee and tobacco in only 15.2 per cent of the cases, while such habits are recorded in 70 per cent of cases in the tuberculosis clinics. The family history is indicated in 19.5 per cent of instances in the general medical clinics and in 91.5 per cent in the tuberculosis cases; and home situation in 38.8 per cent of the general medical against 77.5 per cent of the tuberculosis cases. Occupation is noted on the records of 70.7 per cent of cases in the general medical clinics and 96.5

per cent in the tuberculosis clinics; past health in 53.3 per cent as against 79 per cent; medication in 87.8 per cent as against 94.5 per cent. Treatment other than medication is indicated in 13.6 per cent of the general medical histories and 27 per cent of the tuberculosis records. The general medical clinics record follow-up procedures in only 1.8 per cent of cases, whereas the tuberculosis clinics record home visits in 81.5 per cent. The former record less than 1 per cent of social service histories, and the latter 86 per cent. Progress is recorded in 17.9 per cent of the general medical cases as against 71 per cent of the cases of tuberculosis.

Comparison of tuberculosis with general medical records of other diagnosed diseases in the same institutions shows that the former records are uniformly excellent even in the dispensaries where the general medical records are relatively poor.

Harlem general medical clinic's records indicate medication in 41.6 per cent of cases and progress in 25 per cent, while the Harlem tuberculosis clinic records medication in 100 per cent of cases and progress in 90 per cent. Habits, family history, home situation, past health, occupation and social service, are never found recorded in the Harlem general medical clinic, while the tuberculosis clinic indicates the above items in the following percentages: habits, 70; family history, 100; home condition, 100; past health, 100; occupation, 95; social service, 100.

Comparing Bellevue Hospital's medical clinic with the tuberculosis clinic in that institution, the following items are found recorded in the given proportion of cases, the percentage from the medical clinic being given first in each instance; habits, 4.1–95; family history, 12.5–100; home condition, 20.8–95; past health, 58.3–95; occupation, 45.8–100; social service, 0–100; medication, 91.6–100; progress, 45.8–90.

2. Physical examination. Comparing the procedure of physical examination recorded in the tuberculosis clinics with that for special diagnosed diseases in the general medical clinics, the following differences are noted: the former record 99 per cent of physical examinations against 58.2 per cent for the general medical clinics; the abdomen is examined in 8.5 per cent of cases in the tuberculosis clinics and 12.6 per cent in the general medical; teeth and tongue are examined in 15 per cent of cases in the tuberculosis clinics as against 6.2 per cent and 2.3 per cent respectively in the general medical clinics; and the throat is examined in about 6 per cent of cases in both departments and blood pressure taken in 7.5 per cent of the tuberculosis cases and only 1.8 per cent of the general medical.

The examination of the lungs and the taking of weight, temperature, pulse and respiration, as these are procedures particularly essential to tuberculosis cases, are not compared with the records of other diseases except in such instances as the other disease calls for similar procedure. The examination of lungs is recorded in 98 per cent of tuberculosis cases, but in only 55.4 per cent of cases of chronic bronchitis. Weight is recorded in 99 per cent of tuberculosis cases and in only 16 per cent of cases of malnutrition. The tuberculosis records indicate the temperature in 99 per cent of instances, while the malnutrition records note it in only 27.6 per cent, chronic heart lesions in 26.4 per cent, chronic nephritis in 20.5 per cent and chronic bronchitis in 16.6 per cent of cases. The pulse is recorded in 99 per cent of tuberculosis cases, but in only 35.6 per cent of cardiac cases and 19.7 per cent of cases of chronic nephritis. The respiration is indicated in 99 per cent of tuberculosis, but in only 4.9 per cent of cases of chronic bronchitis, 23.5 per cent of chronic nephritis and 22 per cent of chronic heart lesions.

3. Use of laboratory. In the 200 tuberculosis records studied, some kind of laboratory test was indicated in 98 per cent of cases, whereas in the other special diseases where laboratory tests are considered essential, the proportions of tests were as follows: syphilis of the nervous system, 84 per cent; chronic nephritis and gonorrhea, each 66.7 per cent; and gastric ulcer, 58.9 per cent.

Nephritis and gornorrhea, as would be expected, stand highest in the proportion of cases receiving urinalyses but tuberculosis is well above any other disease, recording 40.5 per cent of cases examined.

In the comparison of X-ray examinations, fracture with 56.7 per cent of records showing such procedure and gastric ulcer with 45.3 per cent are the only diseases with a higher record than tuberculosis, with 34 per cent. The disease with the next highest proportion is chronic nephritis, with 7.8 per cent of X-ray examinations indicated. As regards the Wassermann reaction, tuberculosis, which records 11 per cent of cases examined, is only exceeded by syphilis with 78.2 per cent and epilepsy with 12.2 per cent.

The other common laboratory tests for tuberculosis, such as sputum and von Pirquet, are not comparable with the same procedures for the other diseases, but it is interesting to note in this connection that whereas sputum analysis is recorded in 92.5 per cent of tuberculosis cases, microscopic urinalysis is recorded in only 37.2 per cent of cases of chronic nephritis; X-ray in 56.7 per cent of fractures; smears in 33.9

per cent of cases of gonorrhea in women; and Wassermann test in 78.2 per cent of syphilis cases treated in neurological clinics and 89.1 per cent of those treated in special venereal clinics.

4. Attendance. A comparison of the attendance of the patients suffering from the different chronic diseases is interesting in this connection and it is found that the attendance at the tuberculosis clinics is of a much higher grade, indicating superior supervision in these clinics. The general mean number of visits of the tuberculosis patients under treatment for less than two years is 16; of patients under treatment from two to three years, the mean number of visits is 30; and for those under treatment over three years the number is 48.

The mean number of visits for all cases of syphilis studied in the venereal clinic survey was about 9, while more than one-half of the cases of malnutrition, chronic bronchitis, eczema and gonorrhea in women made only one visit.

5. Social service. The social service histories are filed with the medical records in nearly all of the tuberculosis clinics while these records are usually filed separately in the general medical clinics cases, making the information rather inaccessible to the clinic physician.

COMPARISON WITH VENEREAL CLINICS

1. Supervision of families. One essential feature in the adequate control of both venereal disease and tuberculosis is the supervision and prophylactic examination of the families of clinic patients. Whereas little or nothing is being done at the venereal clinics along this line, the tuberculosis clinics systematically supervise the patient's family whenever possible; and of the families of the 200 cases studied, 246 members other than the original patient are recorded as having had a prophylactic physical examination at the clinics.

2. Treatment of children. Another fact which demonstrates the disease preventive activities of the tuberculosis clinics is the proportion of children examined. In 1918, 39.5 per cent of their patients were children, brought in for medical supervision. This figure again is not available for the venereal clinics but the proportion of children receiving prophylactic supervision at these clinics is very low.

All of the private tuberculosis clinics and all but five of those conducted by the Department of Health hold special sessions for children at some time when it is possible for school children to attend. The

venereal clinics provide only the following facilities for children: Bellevue, special clinics for both syphilis and gonorrhea; Vanderbilt, a special clinic for gonorrhea; and New York Hospital, special hours for women and children.

COMPARISON WITH SPECIAL GASTRO-ENTERIC CLINICS

As it has been found in our survey of medical cases that the same conditions when treated in special clinics receive better attention than when treated in general medical clinics, a comparison is made below of gastric ulcer treated in special clinics at Brooklyn Hospital, and Mt. Sinai dispensaries, with the tuberculosis cases studied.

A physical examination is recorded in 77.3 per cent of all cases of gastric ulcer treated in the special clinics, whereas a physical examination is indicated in 98 per cent of the tuberculosis records.

The abdomen is recorded as having been examined in 68.3 per cent of cases of gastric ulcer in the special clinics, while the lungs were examined in 98 per cent of cases in the tuberculosis clinics. Examination of the teeth is noted for 2.3 per cent of cases in the special gastric ulcer clinics and in 15 per cent of cases in the tuberculosis clinics.

Urinalysis is recorded in 22.5 per cent of cases of gastric ulcer, whereas urinalysis is indicated for 40.5 per cent of the tuberculosis cases studied.

A Wassermann Reaction is noted for 4.6 per cent of the cases in the special gastric ulcer clinics and 11 per cent of the tuberculosis cases.

The 75 per cent of gastric ulcer cases receiving a test meal at the special clinics may be compared with the 92.5 per cent of tuberculosis cases recorded as having had an analysis of sputum as a diagnostic procedure.

This comparison although inconclusive will perhaps serve to indicate and emphasize the superiority of the organization of tuberculosis clinics over other departments of the dispensary.

CONCLUSIONS

There seem to be two chief reasons why the treatment of tuberculosis is relatively superior: first, because of the centralized control of the tuberculosis clinics; and secondly, because tuberculosis is a disease treated in special clinics by physicians particularly interested and expert in its treatment. Moreover, most of the clinic physicians in the tuberculosis departments receive compensation for services.

THE ASSOCIATION OF TUBERCULOSIS CLINICS

1. History and membership. As the relatively high standards of the tuberculosis clinics are due in a great measure to the activities of the Association of Tuberculosis Clinics, a brief resume of the history and activities of this organization may not be amiss in this connection.

The Association of Tuberculosis Clinics was organized in 1908 as an offshoot of the Tuberculosis Relief Committee of the New York Charity Organization Society, for the purpose of eliminating the overlapping and duplication in the work of the various tuberculosis clinics. The Association then consisted of eight clinics as follows: Bellevue, Health Department, Gouverneur, Presbyterian, Vanderbilt, New York Dispensary, New York Hospital and Harlem.

The membership has grown rapidly especially by an increase in the number of Health Department clinics. At the present time there are thirty tuberculosis clinics in the Association, twenty operated by the Health Department, three by Bellevue and Allied Hospitals and seven by private institutions as follows: Lenox Hill, Mt. Sinai, New York Dispensary, New York Hospital, Presbyterian, St. Luke's and Vanderbilt. Several other clinics have been members of the Association from time to time and have resigned for various reasons.

The objects for which the Association was formed have been stated as follows:

> To organize dispensary control of tuberculosis in New York City and to develop a uniform system of operation of such dispensaries as are organized for this purpose; to retain patients under observation until they are satisfactorily disposed of, and to prevent their drifting from one dispensary to another; to facilitate the attendance of patients at the dispensary most convenient to their homes; to facilitate the work of visiting nurses in the homes of patients; to provide for each patient requiring it, assistance by special funds or through benevolent organizations and proper hospitals, sanatorium or dispensary care; to coöperate with, and assist as far as possible, the Department of Health in the supervision of tuberculosis; to do any and all acts and things which may lawfully be done to aid in securing any of the above named objects; and generally to combat and assist in combating tuberculosis and to alleviate and assist in alleviating its effects.

The work of the organization is carried on by an executive staff under the supervision of the board of directors. The functions of this staff are to receive and tabulate information from the monthly reports of the

individual clinics; to make critical studies from time to time of the efficiency of the various dispensaries and make reports of these studies; to prepare annual reports, circulars of information, "Clinic Notes" as described later; and to coöperate with the Board of Health and voluntary health organizations in their activities.

2. *The main achievements of the Association.* Some of the results of the activities of the Association of Tuberculosis Clinics in raising the standard of the tuberculosis clinics can be summarized as follows:

Requirements for admission. The Association established the following requirements for admission to its membership:

Clinics eligible for membership in the Association must be provided with (a) a separate class for tuberculosis cases; (b) a graduate nurse assigned to this class for the purpose of maintaining supervision over the homes of these tuberculosis cases; (c) a district within which the work of the class is limited for new cases.

By insisting on these minimum requirements the Association has been able in many instances to raise the standards of the clinics applying for admission.

District treatment. The Association brought about a district organization of tuberculosis clinic work thus eliminating a great deal of confusion and conserving the time and energy of both patients and the clinic personnel.

Critical studies. Various critical studies of the work of the tuberculosis clinics have been made from time to time and the observations of the work done at the clinics incorporated in reports submitted to clinic authorities for their information and guidance. This constructive criticism has resulted in higher standards of procedure being gradually introduced in all clinics.

Monthly reports. A system of monthly reports from the individual clinics to the central office was instituted by the Association. These reports were of great value to the clinics themselves because they necessitated a monthly checking up of their own activities and also served as a basis of some of the critical studies of the association and of the annual reports.

Regular publications. On the basis of the monthly statements the Association publishes an annual report giving an account of the work of every clinic in the Association. It also issues a monthly bulletin, *Clinic Notes*, and distributes it to the Association members for purposes

of bringing clinics closer together, stimulating healthy rivalry and establishing an esprit de corps among the workers.

A series of circulars of information has been issued to the clinics to keep them in touch with matters of general interest and to inform them of all rulings concerning methods of procedure adopted by the Association or promoted by the Health Department.

Conferences. The Association organized conferences of tuberculosis workers with the aim of discussing the problems encountered in the work and methods of meeting them. The nurses working in tuberculosis clinics were organized into a group with the object of establishing through contact a coöperative spirit and of promoting uniformity in the work.

Coöperation with the Department of Health. The Association has been an influential factor in shaping the development of the tuberculosis clinic work and has set an example of what can be accomplished by similar coöperative effort in other branches of dispensary work.

APPENDIX

TABLE 1A

Nationality of patients attending tuberculosis clinics tabulated by institutions

INSTITUTION	NUMBER OF CASES	UNITED STATES		ITALIAN		HEBREW		IRISH		SLAV		GERMAN		NEGRO		MISCELLANEOUS	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Lenox Hill...	20	9	14.5			5	8.9	2	7.7			1	25			3	18.7
Gouverneur..	20	1	1.6	2	7.4	17	30.4										
Vanderbilt...	20	13	21.0					4	15.4			2	50			1	6.2
St. Luke's....	20	10	16.1	2	7.4			3	11.5			1	25			4	25.0
New York Hospital...	20	7	11.3	3	11.1	1	1.8	6	23.1							3	18.7
Mt. Sinai....	20					20	35.7										
Harlem......	20	6	9.7	1	3.7	6	10.7	3	11.5					3	100.0	1	6.2
Bellevue.....	20	6	9.7	6	22.2	1	1.8	3	11.5	2	33.3					2	12.5
Presbyterian .	20	6	9.7	1	3.7	4	7.1	3	11.5	4	66.7					2	12.5
New York Dispensary	20	4	6.4	12	44.5	2	3.6	2	7.7								
Total......	200	62	31.0	27	13.5	56	28.0	26	13.0	6	3.0	4	2	3	1.5	16	8.0

TABLE 1B

Age and sex of patients attending the tuberculosis clinics tabulated by institutions

INSTITUTION	NUMBER OF CASES	MEN				WOMEN				CHILDREN UNDER 16	
		16–45		45+		16–45		45+			
		Number*	Per cent*	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Lenox Hill	20	6	9.5	3	15.8	5	5.8	3	12.5	3	42.8
Gouverneur	20	9	14.3	2	10.5	7	8.1	2	8.3		
Vanderbilt	20	5	7.9	1	5.2	11	12.6	1	4.2	2	28.6
St. Luke's	20	3	4.8	2	10.5	9	10.4	6	25.0		
New York Hospital	20	5	7.9	3	15.8	12	13.7				
Mt. Sinai	20	8	12.7	1	5.2	10	11.5	1	4.2		
Harlem	20	5	7.9	2	10.5	10	11.5	2	8.3	1	14.3
Bellevue	20	9	14.3			10	11.5	1	4.2		
Presbyterian	20	7	11.1	1	5.2	8	9.2	3	12.5	1	14.3
New York Dispensary	20	6	9.5	4	2.1	5	5.8	5	20.8		
Total	200	63	31.5	19	9.5	87	43.5	24	12.0	7	3.5

* Number and per cent based on number of men, women and children respectively.

TABLE 2

Number of visits made by patients to the tuberculosis clinics tabulated by time under care and institutions

INSTITUTION	ONE TO TWO YEARS												TWO TO THREE YEARS										THREE TO FOUR YEARS OR LONGER									
																					Total										Total	
	5 visits or less	6–15	16–25	26–35	36–45	46–55	56–65	66–100	100+	NUMBER NOT STATED	TOTAL	PER CENT	6–15	16–25	26–35	36–45	46–55	56–65	66–100	100+	Number	Per cent	6–15	16–25	26–35	36–45	46–55	56–65	66–100	100+	Number	Per cent
Lenox Hill......	3	3			1			1		2	10	50			2	1		1	1	1	6	30		1					1	2	4	20
Gouverneur.....		5	2		1						8	40		1	1				2		4	20		2	1		1		3	1	8	40
Vanderbilt......		5	2								7	35		1	2						3	15		2	2	3			2	1	10	50
St. Luke's......		1	5								6	30	3	3							6	30	1	1	2	1	2		1		8	40
Harlem........		1		2		2	2				7	35			1				1		2	10	1		3		1	1	3	2	11	55
New York Hospital.....	1	3	4	2							10	50	1	1		1	1				4	20		1	1		1	1		2	6	30
Bellevue.......		4	4	1							9	45		1	2				1		4	20			1	1	1	2	1	1	7	35
Mt. Sinai......		4	1	2							7	35	3		3	1					7	35	1	1		1		1	1	1	6	30
Presbyterian....		6	2	1							9	45	1		1	3					5	25			2		1		3		6	30
New York Dispensary...			1			2		1			4	20		2	2	1	1		2	1	9	45		1	1		1	1		3	7	35
Total.......	4	32	21	8	2	4	2	2		2	77	38.5	8	9	14	7	2	1	7	2	50	25	3	9	13	6	8	6	15	13	73	36.5
Per cent total	5.2	41.5	27.3	10.4	2.6	5.2	2.6	2.6		2.6	100		16	18	28	14	4	2	14	4	100		4.1	12.4	17.8	8.2	11	8.2	20.5	17.8	100	

Mean number of visits: 1 to 2 years, 16 visits; 2 to 3 years, 30 visits; 3 to 4 years or longer, 48 visits.

TABLE 3

Content of tuberculosis records tabulated by clinics

Clinic	Number of cases	Habits I* recorded: Number	Habits I* recorded: Per cent	Habits II† recorded: Number	Habits II† recorded: Per cent	Family history recorded: Number	Family history recorded: Per cent	Home condition recorded: Number	Home condition recorded: Per cent	Past history recorded: Number	Past history recorded: Per cent	Occupation recorded: Number	Occupation recorded: Per cent	Medication recorded: Number	Medication recorded: Per cent
Harlem	20	19	95	14	70	20	100	20	100	20	100	19	95	20	100
Gouverneur	20	20	100	13	65	20	100	20	100	18	90	20	100	20	100
New York Dispensary	20	20	100	14	70	16	80	16	80	10	50	20	100	20	100
Mt. Sinai	20	20	100	17	85	20	100	10	50	16	80	20	100	20	100
St. Luke's	20	20	100	18	90	20	100	18	90	17	85	20	100	20	100
New York Hospital	20	20	100	17	85	15	75	9	45	16	80	19	95	18	90
Vanderbilt	20	14	70	4	20	12	60	6	30	9	45	16	80	18	90
Presbyterian	20	20	100	10	50	20	100	19	95	17	85	20	100	17	85
Bellevue	20	20	100	19	95	20	100	19	95	19	95	20	100	20	100
Lenox Hill	20	20	100	14	70	20	100	18	90	16	80	19	95	16	80
Total	200	193	96.5	140	70	183	91.5	155	77.5	158	79	193	96.5	189	94.5

Clinic	Other medical care stated: Number	Other medical care stated: Per cent	Laboratory tests recorded: Number	Laboratory tests recorded: Per cent	Home visits recorded: Number	Home visits recorded: Per cent	Revisits recorded: Number	Revisits recorded: Per cent	Progress recorded: Number	Progress recorded: Per cent	Social service recorded: Number	Social service recorded: Per cent
Harlem	3	15	20	100	20	100	20	100	18	90	20	100
Gouverneur	3	15	20	100	20	100	20	100	19	95	20	100
New York Dispensary			20	100	16	80	20	100	15	75	17	85
Mt. Sinai	6	30	20	100	12	60	20	100	9	45	13	65
St. Luke's	14	70	20	100	20	100	20	100	16	80	20	100
New York Hospital	1	5	20	100	12	60	20	100	15	75	13	65
Vanderbilt	12	60	16	80	6	30	20	100	11	55	10	50
Presbyterian	6	30	20	100	20	100	20	100	16	80	20	100
Bellevue	9	45	20	100	18	90	20	100	18	90	20	100
Lenox Hill			20	100	18	90	20	100	5	25	19	95
Total	54	27	196	98	162	81	200	100	142	71	172	86

* Habits I refers to bowels, sleep and appetite.

† Habits II refers to alcohol, tea, coffee and tobacco.

TABLE 4

Distribution of patients to hospitals, sanatoriums, day camps and for convalescent care tabulated by clinics

INSTITUTION	NUMBER HAVING CHANGE		OTISVILLE	SEA VIEW	ST. JOSEPH'S	SETON	METROPOLITAN	BEDFORD	STATE SANATORIUM	DAY CAMP	HOME HOSPITAL	COUNTRY	MONTEFIORE	MISCELLANEOUS	NUMBER OF CHANGES
	Number	Per cent													
Lenox Hill	9	45	1	2		3	1			3	1	1	1		13
Gouverneur	15	75		1		2	2	5	2	6		3	2	6	29
Vanderbilt	13	65	3	3	1				1	6		1		3	18
St. Luke's	13	65	2	2	1	1			2		2	10		4	24
Harlem	9	45	1	1		1			1	1		2		8	15
New York Hospital	9	45	3	3		1			2	1		2		4	16
Bellevue	14	70	4	2	1	3	2			10		1		4	27
Mt. Sinai	14	70	3	2			1	8	2	3		2	1	6	28
Presbyterian	10	30	3	1	1		1	1	2		3			7	19
New York Dispensary	10	50	3	3					1	1				5	13
Total	116	58	23	20	4	11	7	14	13	31	6	22	4	47	202
Per cent			20	17.2	3.4	9.5	6.1	12.1	11.2	26.8	5.2	19	3.4	40.5	

* Number and per cent based on the 116 cases having change.

TABLE 5

Physical examination of tuberculous patients tabulated by institution

CLINICS	NUMBER RECORDED	PHYSICAL EXAMINATION												LABORATORY TESTS					
		Temperature	Pulse	Respiration	Weight	Lungs	Abdomen	Teeth	Tongue	Glands	Throat	Skin	Blood pressure	Sputum	X-ray	Urine	Wassermann	Fluoroscope	Other
Lenox Hill	20	20	20	20	19	20		2	4		1	3	1	18	4	13	2	4	
Gouverneur	20	20	20	20	20	20		9	9				8	20	10	16	2		
Vanderbilt	20	20	20	20	20	16	1	5	6		4	2	1	14	3	10	2		2
St. Luke's	20	20	20	20	20	20	4	6	6	1	2		1	19	8	3	4		1
New York Hospital	19	19	19	19	19	20	2	2				3		17	9	7	2	1	
Mt. Sinai	20	20	20	20	20	20	3	3	3		3	1		19	17	7	2		2
Harlem	20	20	20	20	20	20								20	4	1			
Bellevue	20	20	20	20	20	20	1	2	2		2			19	4	5	2		
Presbyterian	20	20	20	20	20	20	6	1	1				4	19	9	16	6		
New York Dispensary	19	19	19	19	20	20								20		3			
Total	198	198	198	198	198	196	17	30	31	1	12	9	15	185	68	81	22	5	5
Percent total	99	99	99	99	99	98	8.5	15	15.5	0.5	6	4.5	7.5	92.5	34	40.5	11	2.5	2.5

EDITORIAL

A PROPOSED SANATORIUM UNIVERSITY

The Swiss-French Universities of Geneva, Lausanne and Neuchâtel have issued a circular appealing for funds to establish a sanatorium in which students and professors alike may continue studies while under treatment. The idea makes a strong appeal. It is surely in line with modern ideas of the value of mental and physical occupation in quiescent periods of tuberculosis.

The suggestion comes from Dr. L. Vauthier (Secretary-General) of Geneva, and a committee appointed from the three universities named. An effort will be made to raise $2,000,000 for the establishment. Free treatment would be provided for those unable to pay. The scheme is for a separate institution under the patronage of the three universities.

The privileges at first contemplated will be limited; and students admitted only from the United States, Belgium, France, Great Britain, Greece, Italy and Switzerland. Many subjects would be taught to suit the varied needs, tuberculous professors being engaged when this is desirable and when they are physically fit.

Switzerland offers undoubted advantages for trying such a plan. If well provided with medical direction and infirmary facilities; and, above all, if sufficiently endowed, there is new hope for the discouraged student cut off in the course of his studies.

It is worth mentioning that in the United States, universities in the West and Southwest are at present giving instruction to ex-service men with arrested tuberculosis, under the Federal Bureau for Vocational Education. There are numbers of students from Eastern colleges who by reason of tuberculosis have finished their education in Western colleges.

The proposal to combine the sanatorium and university is a logical thing. We hope that American assistance will be furnished to the Swiss experiment.

E. R. B.

TUBERCULOSIS PROBLEMS

Tuberculosis problems change. And the fact that they do change is the best proof that we are not standing still. The current number of the REVIEW does not voice a single new thought; yet could our departed heroes of tuberculosis of only ten years ago scan its pages they would perforce rub their eyes. For their tuberculosis problems have slunk o the rear. The tubercle bacillus is no longer tuberculosis; it has become a mere incident of tuberculosis. The man sick with tubercle is now tuberculosis. Around such men centers the tuberculosis problem of a new day. That tubercle bacilli are in men no longer hurries a chill down our spine. This fact we have come to accept,—just as we accept our sins,—our hates and our lusts, our covetousness and our pride. Moral science cannot deny their existence; good morals demand that they lie dormant and concealed.

Pause now for a moment. Brush up for an hour on the tuberculosis exhortations that ushered in the century and promised to the populace a new world. How? By slaughtering cattle, by abolishing spitting, and by teaching and taking care of the sick for a few months. But human nature is cantankerous. Its human right to spit far and wide will not be yielded to a remote and shadowy peril. Or is it that human nature resents the imposition of law? Made tolerably whole and sound once more, the sanatorium graduate remains disappointingly perverse to our admonitions and our homilies. We take him by the hand and we tell him to eat to fulness of good food, to rest much in clean air, not to overwork, not to overplay, not to tire; and we send him home. And at home he eats what is there, and rests where he can, and overworks and, may be, overplays, and he tires—often; and he comes back to us. And we condemn him—only too often—for his foolishness and disobedience.

Irony stalks the lunger at every turn; and by no means the least ironic episode in his sorry career is that session with the physician when his home regimen is worked out,—a regimen that not more than ten per cent can command and enjoy. It is the irony that would prescribe a winter at Palm Beach for your washerwoman's bronchitis.

But we are learning. Turn now to preceding pages. From across our Northern Border, from the Pacific Coast, from the Atlantic Seaboard, comes the appreciation that the key to the problem lies buried in the condition of the social mass; in urban and rural general health

and sanitation, in wages and the cost of commodities, in housing and in rents, in hours of work, and ideals and habits of play and recreation;—in short, to paraphrase Stewart's brilliant summary, in everything that enters into an individual's life. It is his reaction to his environment that brings him to the sanatorium; it is his reaction to the ideal environment of the sanatorium that sends him out apparently cured; it is his reaction to environment that sends him back to the sanatorium. The problem of prevention lies in the character of the social mass: here too lies the problem of the permanent cure of tuberculosis. In this fight of ours the sanatorium is in no way the beginning and end of the struggle. It is a link—a way station; but by all odds the most important way station, the one most fruitful in results, yet devised or imagined. It is not the sanatorium's fault that men come to it: society must answer for this. Nor is it through any shortcoming of the sanatorium that men return to it: for this again society is accountable.

Nothing can be plainer than that it is on and through society that we must work. But with what tact! What sympathy! What most humanistic appreciation of the fundamental roots of human nature! Whatever comparisons and analogies eugenists may draw from the race-track and the barnyard, we as workers in tuberculosis should never forget that we are dealing with human beings. In bringing to pass a new breed of animals—a fairer, a stronger and a more resistant stock—we must see to it that we do not destroy a race of men. Pity, and sympathy, and love of the good and beautiful, and creativeness are not always the heritage of the swift, the sleek and the strong, nor the possession of the fine-upstanding, the sound-bellied and the taut-muscled alone.

We gain nothing; nay, we lose all that we have, if in our zeal we violate a single one of those fine traits of the emotions that mark us off from the brutes. We must be ever careful that we do not create a situation that would be more intolerable than the one we try to escape from. Would the world really be better off if, as Dobbie suggests, a tuberculous mother were not allowed to come in contact with her child during its first three years or a tuberculous father forbidden to live in the same house with an infant under three? The wise physician must hesitate to tell an innocent and happy wife that her erring consort has acquired syphilis: he has a responsibility in addition to that of saving her *body*, and perhaps the former responsibility is the greater one. This may be a fine point for casuistry. But there can be hardly two opinions

as to how many would advocate the annual disruption of a half million homes in this country alone, because of tuberculosis.

To keep in view the whole man; to work unceasingly for the betterment of the physical conditions under which he lives; to promote and develop opportunity for advancement along paths that involve the least unnecessary strain,—and to do all this with a minimum of terrorism, whether this *Schrecklichkeit* be by precept, by threat or by statute law, but with a maximum of tolerance of and regard for and adaptation to the conservative demands and the creative yearnings of human nature;—this is the "root and branch" attack on tuberculosis. Sensational and exciting, this? No. But peoples without the materials for the historian are happiest; the times of peace are dull, yet charged with work and productiveness and wealth; scientific eras should be rated, not according to the brilliance or number of their flashy discoveries, but according to their total of achievement and addition to knowledge and ideas. So perhaps in a period of work and quiet orientation like the last decade we in tuberculosis may have gone ahead further than when a Laennec or a Koch flashed across our world.

A. K. K.

NEW TUBERCULOSIS ASSOCIATION, NEW YORK CITY

The antituberculosis work in New York City which, for the past seventeen years, has been thoroughly and energetically carried on by the Committee on the Prevention of Tuberculosis of the Charity Organization Society, has been taken over by a new and larger corporation, the New York Tuberculosis Association, Inc. All the members of the old committee, including such prominent workers in the tuberculosis field as Dr. Hermann M. Biggs, State Commissioner of Health; Dr. Royal S. Copeland, Health Commissioner of New York City; Mr. Lee K. Frankel; Dr. S. S. Goldwater; Mr. Thomas W. Lamont; Dr. S. Adolphus Knopf and others are members of the Board of Directors of the new Association.

The objects of the Association are: The study of tuberculosis and of the means of preventing it; the dissemination of knowledge as to the nature of the disease, its causes and the methods of its prevention and its treatment; the promotion of adequate facilities for the prevention of tuberculosis and for the care, treatment and economic rehabilitation of persons afflicted therewith; and the coördination of the work of public and private agencies engaged in any of the foregoing activities.

Dr. James Alexander Miller is the president of the Association and Mr. Homer Folks is the vice-president. Dr. John S. Billings, long connected with tuberculosis work in New York City, is the Director.

A broad program of education, publicity, preventive work among children, of home treatment and after-care, coördination of existing clinics and of relief agencies, will be developed by experienced secretaries. A novel addition, in coöperation with the Federal Vocation Board, will be the opening of a workshop where, under the best sanitary conditions and medical supervision, arrested cases of tuberculosis will be restored to productive capacity under healthy surroundings.

Among the secretaries so far appointed are: Mr. G. J. Drolet, statistician; Miss Gretta Jones, relief organizations; Mrs. Josephine Toering, tuberculosis dispensaries; Mr. E. C. Rybecki, labor; Mr. David Ryan, publicity.

INFLUENZA AND TUBERCULOSIS

A SUPPLEMENTARY REPORT AND CRITICAL REVIEW

J. BURNS AMBERSON, Jr. and ANDREW PETERS, Jr.

From the Loomis Sanatorium, Loomis, New York

One of the questions reopened since the influenza pandemic of 1917–1918 is that of its effect on pulmonary tuberculosis. Incidentally, the question has also arisen of the susceptibility of tuberculous persons to this infection, and its course in such individuals. It has been assumed by some from comparatively meagre data that the tuberculous possess a special immunity to influenza.

Some months ago we (1) recorded our observations on epidemic influenza among a comparatively small number of patients and employees at Loomis Sanatorium, and we now wish to supplement this report with an analysis of the histories of patients who had epidemic influenza previous to entering the sanatorium and to note the incidence and fatality of this disease among our former patients. We shall attempt, furthermore, to correlate this with evidence from other sources and to point out what we consider errors in interpretation of this data.

Statements have been made that influenza is less prone to attack the tuberculous than other individuals; that when it does it runs a milder course; and, on the other hand, that mild and incipient cases of phthisis show a special liability to influenza.

The impression that influenza is less prone to attack the tuberculous seems to have been supported chiefly by statistics reported by Armstrong (2) for the first epidemic at Framingham, Mass. There the incidence among the entire population was 16 per cent; among the tuberculous group only 4 per cent. Most of the tuberculous cases were said to be ambulatory and of the arrested type, exposed to ordinary contacts. However, it seems likely that, as Framingham is a health demonstration community, the tuberculous would be more careful to avoid crowds and over-fatigue, factors fairly clearly demonstrated as contributory to respiratory infections of such types as influenza. The low incidence of influenza in certain tuberculosis sanatoria and hospitals has been cited.

Fishberg (3), in a recent article, quotes Goldberg's figures showing an incidence of 5.4 per cent among hospitalized tuberculous patients at Chicago and compares this with the much higher incidence of the epidemic in the various military camps. It must occur immediately that such a comparison is grossly inapplicable, for the reason that conditions in a military cantonment have no similarity to those in a hospital for the tuberculous. In the former there is every opportunity for contact with sources of acute respiratory infection; in the latter the patients are to a considerable degree segregated. Moreover, as Heiser (4) has pointed out, the mere quartering of men in barracks seems to have a tendency to increase the risk from acute respiratory diseases.

The rôle of acute fatigue as a contributory cause of pneumonia has been pointed out by Cowles (5) who suggested that the conditions observed by him at Groton School might be paralleled at the military encampments where strenuous military training among great numbers of young men provided the conditions for inducing acute fatigue among those physically out of condition or convalescent from mild ailments, and it is reasonable to suppose that acute fatigue may be contributory to influenza as well as pneumonia.

A priori, one would say that patients at tuberculosis sanatoria, usually located apart from the main centers of population, who are for the most part confined to the sanatorium grounds or vicinity, who rest and usually sleep in the open air, and who are well cared for and not subjected to overcrowding or to hardships of any kind, would be much less likely than the ordinary population to contract such a disease as epidemic influenza. However, while the incidence at some sanatoria was low, at others this was not the case. Hawes's report (6) of the epidemic among the Massachusetts State Sanatoria showed that, while Lakeville (up to that time) had escaped entirely, at Rutland, where there was less control over the patients, most of whom were ambulatory, 66 of 360 patients (18.3 per cent), and 32 of 150 employees (21.3 per cent) contracted the disease. This is not far from the general rate of incidence and does not seem to indicate any special immunity. At Montefiore Home (7) the proportion of tuberculous patients and employees contracting influenza was practically the same as among the nontuberculous employees, and about the same percentage of both groups developed evident bronchopneumonia.

As a matter of fact, there was a wide variation both in the incidence and severity of the pandemic in different communities and even in differ-

ent groups of the same community. For instance, among the employees at various Chicago telephone exchanges the attack rate was observed by Jordan, Reed and Fink (8) to vary from 5 per cent to 27 per cent, although the working conditions were approximately the same. The influence of careful supervision of a somewhat segregated group was shown in one section of the Students' Army Training Corps, the attack rate being 3.9 per cent, and the pneumonia rate 7.7 per cent; whereas in another section of the Corps particularly exposed to infection, the attack rate was 39.8 per cent and the pneumonia rate 13 per cent. In groups from the larger communities studied by Frost (9), the percentage of the population attacked varied from 15 per cent in Louisville, Kentucky, to 53.3 per cent in San Antonio, Texas, the attack rate for the whole group being 28 per cent.

For the belief that influenza lays a lighter hand on the tuberculous than on the nontuberculous we can find still less evidence. Fishberg (3), indeed, says that in most cases seen in private practice, tuberculous patients passed through influenza uneventfully, and adds that he has not seen a single fatal case. He makes the still more extraordinary statement that "a large proportion of tuberculous patients under treatment in this city (New York) contracted influenza and not a single one succumbed." In contrast to this, among the comparatively small number of tuberculous individuals who were attacked by the disease at Loomis Sanatorium (1), there were two deaths.

Of 1227 former patients of Loomis Sanatorium concerning whom we have definite reports, 70 contracted influenza during the epidemic of 1917–1918, and 16 of these (22.9 per cent) are reported to have died. This is much higher than the general case fatality, which rarely exceeded 5 per cent, and on the average seems to have been considerably less (9). Even granted that a certain (unknown) number of our former patients had the disease, recovered and forgot to mention it in their reports, the fatality percentage of our group must have been well above this. Pearl (10), in a preliminary analysis of the weekly mortality statistics of the epidemic for 39 large American cities, noted the extraordinary degree of variation in the relative degree of explosiveness of the outbreak of epidemic mortality. Analysis of this variation, by the method of multiple correlation, appeared to demonstrate that an important factor in this was the magnitude of the normal death rates observed in the same communities, particularly from pulmonary tuberculosis and diseases of the heart and kidneys.

It is difficult to agree with Fishberg that epidemic influenza is primarily merely an upper respiratory tract infection and affects the bronchi and lungs in only a relatively small proportion of cases. It has many characteristics of a general infection in well-marked cases and affects the lower respiratory tract so frequently that the term "epidemic pneumonitis" has been used. The dominance of pulmonary symptoms has been frequently referred to, and Christian (11) believes, from a clinical study of non-fatal cases at the Peter Bent Brigham Hospital, that with very few exceptions patients with fairly severe to severe cases of influenza have bronchopneumonia.

Perhaps the most disputed question of all is that of the effects of influenza on preëxisting tuberculosis, latent or manifest, and the evidence is indeed frequently confusing. Hawes (12), Fishberg (3), Stivelman (7), Gram (13) and a number of other writers on the subject are evidently of the opinion that these effects are inconsiderable. In fact, Fishberg goes so far as to conclude that epidemic influenza is not to be considered as a reactivator of dormant tuberculous lesions. However, some of this evidence is not entirely convincing. For example, Fishberg quotes Rickman who reports that in 30 out of 40 tuberculous persons at St. Blasien who contracted influenza the attack did not produce any aggravation of the lung condition; but we are not informed as to what happened to the other 10. Surely if even 25 per cent of tuberculous patients who contract influenza have their pulmonary condition aggravated, we should not regard tbis as inconsiderable. Stivelman reports that there were 6 fatal issues among the tuberculous at Montefiore Home who had the disease, a mortality of 11.4 per cent. Three of the 6 patients "died from exhaustion due to marked reactivation of the tuberculous lesion two months after the onset of influenza."

That in many cases following influenza it is difficult to say just what is and what is not a tuberculosis exacerbation is admitted, but to throw out all except the cases which become rapidly progressive toward a fatal issue with the tacit assumption that the remainder had been unharmed would scarcely be warranted; for we know that relapses in tuberculosis can occur without very obvious increase in extent of the physical signs, and that recovery may ensue, not all by any means continuing to progressive disease. In other cases it may be a long time before the physical signs in the chest show definite increase in extent.

In Gram's (13) survey of the after-effects of the epidemic in the City of Buffalo, of 33,880 cases of influenza reported, 25,699 were visited and

investigated by emissaries of the Department of Health, much of the field work being done by lay individuals appointed as extra inspectors for the emergency, and altogether occupying a period of about two months from the subsidence of the pandemic. Seven hundred and forty-eight individuals were at first reported as not fully recovered and were given further attention, 220 having various respiratory sequelae. One hundred and forty-two of these had coughs later reported as recovered from or improving, 13 "colds" and 12 "lung trouble" later reported as recovered, leaving only 27 cases of tuberculosis or suspected tuberculosis, of which only 8 were definitely new cases of tuberculosis, certainly an insignificant number. But it is not to be expected that by such a canvass, however earnest the endeavor, the full tale could be told. There is still a widespread disinclination to tell the agents of Boards of Health any more than can be helped, and doubtless many minimized or suppressed their disabilities. It was only possible to examine a comparatively small number. In commenting on Gram's paper when read before the American Medical Association, A. L. Franklin, of Cumberland, Maryland, observed that the Buffalo experiment would have been much more valuable had it been possible to apply a careful medical examination to several thousand of these apparently recovered patients, while E. B. Freilich of Chicago said there were observed in the dispensary clinics, almost daily, moderately and far advanced cases of tuberculosis with histories dating back to influenza, and also that the general attendance at these clinics had increased. B. R. Wakeman reported the results of a post-influenza survey at Hornell, New York, where out of about 400 persons examined who had not fully recovered, 40 were found to have tuberculosis, yet only 2 cases had been reported to the health officer from January 1 to October 1, 1918. Finally, Sir Arthur Newsholme of London remarked that, so far as national statistics in England were concerned, every year showing an excessive death rate from influenza has been followed by a year in which the death rate from tuberculosis has been excessive. Apparently this has not, at least as yet, been the case in this country, if we consider the figures thus far reported. Fishberg (3) quotes those published by the New York City Department of Health showing that between January 1 and September 1, 1919, there were reported 1026 fewer cases of tuberculosis and 549 fewer deaths from this cause than in the corresponding period of 1918. However, during the succeeding three months of 1919 (14), although the number of deaths reported from tuberculosis continued to be less than for the same months of the previous

year (when incidentally there was a temporary increase during the period of the influenza prevalence) the number of cases reported in the same city has shown a distinct increase over the latter months of 1918, the number reported in October 1919 being 1292, and in November 1527, which more than erases the balance in favor of the latter year. Are we beginning to get some late fruits of the pandemic or is this the result of some undetermined transient factor? As regards the immediate diminution in deaths reported from tuberculosis, may it not be that the pandemic carried off enough of the old cases to account for a temporary lull until new cases developed or others had time to reach later stages of the disease? We believe it would be premature to attempt to formulate positive answers to these questions at present and that we must await more extensive statistics covering a longer period, as well as a more careful analysis of the factors involved in the present data, to determine the effect of the pandemic on tuberculosis or tuberculosis mortality in this country. The following conclusions reached by Louis I. Dublin (15), statistician of the Metropolitan Life Insurance Company, based on a study of the mortality experience from tuberculosis in the industrial department of the company in 1918, are, however, instructive:

> The death rate from tuberculosis (all forms) in 1918 continued to decline, the rate being 187.4 as compared with 188.9 in 1917. . . . . The improvement in 1918 as compared with 1917 would have been much greater but for the last three months of the year . . . . for the last three months, the rate was 15.8 per 100,000 higher than the 1917 rate. The tuberculosis death rate usually drops considerably in the last quarter of the year, but in 1918, probably because of the influenza epidemic, there was next to no decline. Exactly similar conditions are found in the population figures for both the state and city of New York.

From 1544 living former patients of Loomis Sanatorium queried up to October 31, 1919, there have been received 1290 replies. There was an insignificant increase (1.78 per cent) in the number of deaths reported this year as compared with the number for 1918, but of the 86 deaths, 16 or 18.6 per cent were caused by pandemic influenza. Out of 1227 returns which contained definite information, 70 or 5.7 per cent report the occurrence of influenza during the year. Death resulted directly from this disease in 16 or 22.9 per cent of these 70 persons, and 2 others died of tuberculosis some months after convalescence from the epidemic. One of these latter had been in poor health for three years but the other

was in a satisfactory condition before the attack of influenza. Of the 52 survivors among the 70, 35 or 67.3 per cent are at present in a satisfactory condition,[1] as compared with 82.6 per cent of all our living ex-patients. Nevertheless, owing to the comparatively small number of those who contracted this disease, its influence as a factor in the total mortality is but dimly reflected, because attenuated and balanced by other indeterminable factors. It is probable that a certain (probably not large) number of cases of influenza among our former patients have not been reported, and that if these were included there would be some increase in the percentage of incidence and corresponding decrease in the percentage of fatality. A detailed summary follows:

Number of former patients who contracted influenza	70	= 5.7 per cent
Persons whose condition was satisfactory, and remained so after the attack	35	= 50.0 per cent
Relapses of pulmonary condition apparently due to influenza	8	= 11.4 per cent
Persons whose condition was unsatisfactory before the attack and still remains so	6	= 8.6 per cent
Persons whose condition was unsatisfactory before the attack but improved since	3	= 4.3 per cent
Deaths due to influenza	16	= 22.9 per cent
Deaths due to tuberculosis after convalescence from influenza	2	= 2.8 per cent
Total	70	= 100 per cent

Finally, we may consider the histories obtained from patients who have been admitted to Loomis Sanatorium during the past year.

From November 1, 1918, to November 1, 1919, there were admitted to the Main Division 199 new patients with unquestionable pulmonary tuberculosis. We have excluded from consideration all those in whom we felt there could be any reasonable question as to the diagnosis, and nearly all the 199 had both definitely manifest physical signs and tubercle bacilli in the sputum. We purposely confined ourselves to patients admitted to the Main Division as these were more directly under our observation and the histories were all very carefully obtained by one of us (P.). Forty-two of these patients, or 21.1 per cent, gave a history of a definite attack of influenza during the recent pandemic. While we agree with Fishberg that probably many of the histories of attacks of so called "grippe" or influenza, obtained from tuberculous patients in times prior to the epidemic, need to be accepted with the

[1] The term "in satisfactory condition" implies that the individual is living under approximately normal conditions and able to attend to his or her ordinary occupation.

proverbial grain of salt, we do not think that objection very valid in the cases in question, for the onset of a genuine, well-marked attack of influenza during an epidemic of the same disease is very typical. Its abruptness, with rapid prostration and sharp rise in temperature and development of acute catarrhal symptoms, bears very little similarity to the ordinary exacerbation of a preëxisting tuberculosis. Later, after the course has become less acute, and when pulmonary complications may have developed, the distinction is not so clear. In addition to the 42 patients just mentioned, 5 others *probably* had influenza, but the history of the attack was less clear-cut, making 47, or 23.6 per cent; 2 others *possibly* had influenza, but as there was some doubt of it they were eliminated.

Of the 42 who had definite influenza, 18 knew they had tuberculosis prior to the attack and 26 in all (8 additional) gave a history of previous symptoms presumably due to tuberculosis. In 12 of these either a long period, sometimes years, had elapsed during which there had been absence of symptoms or apparent quiescence of disease, or else the previous symptoms had been slight and the subsequent ones severe or progressive, or else there had been evident exacerbation of symptoms in cases of long-standing disease with previously only a low grade of activity. Thirteen of the 42 (31 per cent) were perfectly free as far as can be determined from any known or presumable clinical tuberculosis prior to the epidemic, while in 3 others the previous symptoms suggestive of tuberculosis were very indefinite or doubtful.

In 12 cases out of the 42, or 28 per cent (6 per cent of the total 199), the onset of definite clinical tuberculosis appeared to be quite clearly post-influenzal, and all but one of these patients showed tubercle bacilli in their sputum. In 2 more cases the onset was apparently also post-influenzal, but there was an intervening period of several months before definite tuberculosis showed itself; 1 other case had previously had non-pulmonary manifestations of tuberculosis. The present classification of the 12 definitely post-influenzal tuberculosis cases is as follows: Incipient 1, Moderately Advanced 7, Far Advanced 4. Their present prognoses appear to be: Favorable 6, Doubtful 3, Unfavorable 3.

We desire especially to note the group in which tubercle bacilli appeared in the sputum after the acute infection, since Fishberg (3) leaves the impression that this has not been observed. In this connection attention should also be called to the report of Berghoff (16), who made his study at Camp Grant. Of 17 cases of healed or quiescent pulmonary

tuberculosis involved in the epidemic, 13 survived and of these, "6 cases or approximately 50 per cent showed a reactivation and a positive sputum after an attack of influenza." The mechanism of reactivation of latent or quiescent tuberculosis by influenza has not been determined but it may be analogous to the well known tendency of measles, and to a less extent of other acute infections, to activate tuberculosis. The analogy is strengthened by the observations of Bloomfield and Mateer (17) that in influenza as in measles cutaneous sensitiveness to tuberculin is depressed.

In order to exemplify the relation of influenza to certain tuberculous cases that have come under our observation since the epidemic the following case records are abstracted as illustrating various points:

Case no. 4368. Miss S., aet. thirty-two, single, American. Definite previous illnesses include measles in childhood, appendicectomy in 1915, gastric hemorrhages in 1916 and operation for gastric ulcer in March, 1917. Following this operation she had a slow convalescence but she felt well during the subsequent winter and resumed her ordinary life. In the spring of 1918 she felt "run down" and in May had a small hemoptysis. She was sent to the mountains for the summer and was able to resume her usual life in the fall. February, 1919, she contracted influenza and was ill three weeks with fever to 102°F. Her fever subsided but cough persisted. She attempted walking but her cough got worse and slight fever appeared. She had pains in the chest and fever went to 102°F. She lost weight and strength and had sore throat. Her fever persisted.

Admitted to Loomis Sanatorium, May 19, 1919.

Diagnosis: Moderately advanced pulmonary tuberculosis. Indications of active progressive disease.

Roentgenological diagnosis: Infiltration of right lung, especially in upper lobe where there is an early cavity and at base where there is an area of consolidation. The left lung markings appear to be within normal limits.

Sputum: Positive in March, 1919, and at intervals since then.

Course in sanatorium: Following hemoptyses, artificial pneumothorax was induced on right. This was continued with partial alleviation of symptoms from June 1 to July 11, 1919, when signs of disease in left lung appeared. Since then course of disease has been active and progressive and the prognosis is unfavorable.

This case represents in our opinion a definite reactivation of disease following influenza. There is little question that there was a rapid extension of the lesion in the right lung, since competent examination had dis-

closed only a limited involvement previous to the attack, and sanatorium treatment seemed not necessarily indicated. The diagnosis of influenza was also made by a competent physician.

Case no. 4417. Mrs. M., aet. twenty-six, married, Cuban. Previous health good. Measles followed by typhoid fever in February, 1918. During course of latter patient had one hemorrhage from the mouth. However, it seems probable that she really had typhoid fever, as she was ill six weeks and had several large hemorrhages from the bowel. No cough. Made good recovery and was well until she contracted influenza in October, 1918. Was ill in bed with fever ten days. Since then persistent cough and expectoration and recurrent fever. In December, 1918, had pains in right side and back and several weeks later (December 20) coughed up several ounces of blood. Following this had high fever for a week or ten days; slight rises afterward. In bed two weeks. Came to America May 30, 1919, and rested in a boarding house in Liberty.

Admitted to Loomis Sanatorium July 31, 1919.

Diagnosis: Moderately advanced pulmonary tuberculosis. Indications of slight clinical activity.

Roentgenological diagnosis: Consolidation and cavitation in right lower lobe (below fourth rib) with few light parenchymatous deposits above this.

Sputum: Positive for tubercle bacilli since admission.

Course in sanatorium: Patient gained weight and was considerably overnourished. Cough and expectoration persisted and patient had irregular intervals of fever up to 101.8°F. (rectal).

Discharged December 6, 1919, as "improved."

Here the lesion is almost entirely basal. It seems probable that there was a preëxisting quiescent or latent pulmonary lesion but definite and persistent symptoms of activity did not appear until after the influenzal attack. The anatomical distribution and the sequence of symptoms alone would present a picture to be confused with non-tuberculous post-influenzal infection, the sputum examination being the determining diagnostic factor.

Case no. 4373. Mr. B., aet. twenty-one, single, American. Previous health good. Measles and pertussis in childhood. Attended school and college and was a member of the Students' Army Training Corps, from which he was discharged in good physical condition December 17, 1918. March, 1919, had epidemic influenza. At end of a week left bed and three or four days later resumed college studies. Was tired and listless and physician discovered fever that lasted over a week. Slight cough and expectoration, the latter containing no tubercle bacilli in several examinations. Patient returned home and

rested outdoors and then took treatments (baths, massage, etc.) at a health resort.

Admitted to Loomis Sanatorium May 24, 1919.

Diagnosis: Moderately advanced pulmonary tuberculosis. Indications of slight clinical activity.

Roentgenological diagnosis: Heavy infiltration of right upper; less marked of right middle lobe. Moderate grade of infiltration of left upper lobe. Probably cavitation in right upper.

Sputum: Negative for tubercle bacilli in March, 1919; positive May 15, 1919, and at intervals since then.

Course in sanatorium: Disease has become quiescent, patient is free of prominent symptoms and the prognosis seems favorable.

In this case a normal healthy individual is free from all symptoms of disease previous to an attack of influenza. The logical conclusion is that influenza was the agent instrumental in kindling anatomical or dormant tuberculosis into clinical disease.

Case no. 4516. Mr. L., aet. twenty-four, married, American. Previous illnesses included measles, pertussis and scarlet fever in childhood. Health otherwise good although habits of life were irregular. In October, 1918, patient contracted influenza and was in bed four weeks. During this time developed cough and expectoration which has persisted ever since. Also spat up blood several times. Returned to work, but feeling of weakness and malaise, together with cough and expectoration, persisted. In April and May had night sweats. Went to Catskill Mountains for two months with benefit; gained weight and cough was better. On returning home, however, symptoms recurred. Several physicians told patient his trouble was post-influenzal. Finally in September, 1919, sputum was found positive for tubercle bacilli.

Admitted to Loomis Sanatorium January 12, 1920.

Diagnosis: Moderately advanced pulmonary tuberculosis. Indications of moderate clinical activity.

Roentgenological diagnosis: Parenchymatous infiltration of upper half of right lung with scattered light deposits in lower half; moderate cavitation of upper lobe. Infiltration of upper third of left lung with multiple small cavities. Few light deposits in lower half.

Sputum: Positive for tubercle bacilli in September, 1919, and on admission to sanatorium.

Here again a healthy individual develops clinical tuberculosis immediately following influenza. The record of previously good health and sequence of events as noted provides evidence convincing though neces-

sarily presumptive. The story in this instance is a protest against ignoring the possibility of tuberculosis as one of the sequelae of epidemic influenza. Because of such oversight this patient was denied proper treatment for more than a year, and the prognosis is proportionately less favorable.

CONCLUSIONS

1. We do not consider that conclusive evidence has been presented that tuberculous individuals possess an immunity to epidemic influenza not possessed by the nontuberculous. Where there has been a lower rate of incidence in a tuberculous group we believe careful investigation will reveal other factors to account for it.

2. What evidence we possess does not lend any support to the belief that the usual severity of an influenza attack is less among the tuberculous than among the nontuberculous; on the contrary pulmonary complications seem equally frequent, and our statistical records indicate that the case fatality of influenza among the tuberculous was higher than among the general population.

3. In a certain number of individuals—a number large enough to deserve serious consideration—epidemic influenza marks the inception of definite pulmonary tuberculosis which did not previously exist as clinical disease. The onset of pulmonary tuberculosis following influenza may be rapid and immediate, or insidious and remote. In a few cases the course of the pulmonary lesion is rapidly progressive. We believe that to ignore or deny the possibility of pulmonary tuberculosis as a sequela is to unduly defer diagnosis and treatment of a number of patients requiring treatment, with resulting limitation of their chances for recovery.

4. Among those already tuberculous, influenza MAY to a varying degree reactivate quiescent or apparently inactive lesions. Such reactivation may be marked by a temporary exacerbation of symptoms of short duration or by the classical evidences of a severe relapse,—progressive loss of weight and strength, persistent malaise, fever and night sweats, persistently increased cough and expectoration, hemoptyses, pleurisy, and definite progress in the extent and degree of pulmonary involvement. That a large number do not pursue such a course and escape definite permanent damage is not denied.

We desire to acknowledge with thanks helpful suggestions made by Doctor Bertram H. Waters, Physician-in-Chief of the Loomis Sanatorium.

REFERENCES

(1) Amberson, J. B., Jr., and Peters, A. Jr.: Amer. Rev. Tuberc., Aug., 1919.
(2) Armstrong, D. B.: Bost. Med. & Surg. Jour., Jan. 16, 1919.
(3) Fishberg, M.: Amer. Rev. Tuberc., Nov., 1919.
(4) Heiser, V. G.: Jour. A. M. A., Dec. 7, 1918.
(5) Cowles, W. N.: Bost. Med. & Surg. Jour., Oct. 31, 1918.
(6) Hawes, J. B. 2nd: Ibid., Jan. 9, 1919.
(7) Stivelman, B.: New York M. J., July 5, 1919.
(8) Jordan, E. O., Reed, D. B., and Fink, E. B.: U. S. Publ. Health Rep., July 11, 1919.
(9) Frost, W. H.: Jour. A. M. A., Apr. 2, 1919.
(10) Pearl, R.: U. S. Publ. Health Rep., Aug. 8, 1919.
(11) Christian, H. A.: Jour. A. M. A., Nov. 9, 1918.
(12) Hawes, J. B. 2nd: Med. Clinics North Amer., March, 1919.
(13) Gram, F. C.: Jour. A. M. A., Sept. 20, 1919.
(14) U. S. Publ. Health Rep., 1919.
(15) Dublin, L. I.: Quoted in Jour. Outdoor Life, Nov. 1919.
(16) Berghoff, R. S.: Amer. Rev. Tuberc., Aug., 1919.
(17) Bloomfield, A. L. and Mateer, J. G.: Ibid., May, 1919.

THE USE OF SODIUM GYNOCARDATE "A" IN PULMONARY TUBERCULOSIS[1]

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One of the many preparations used in former generations in the treat ment of pulmonary tuberculosis was chaulmoogra oil. Apparently the drug did not prove effective inasmuch as we do not find it mentioned in modern text books as a medicinal remedy for consumption.

Sir Leonard Rogers in an article in the *Indian Journal of Medical Research* of October, 1917, reported 12 cases of leprosy treated with exceedingly good results by the use of a sodium salt of this oil. This salt is known as sodium gynocardate "A". Rogers suggested in his paper that, inasmuch as there existed a similarity in the structure and bacteriology of the bacillus of leprosy and the bacillus of tuberculosis, sodium gynocardate might be of value in the treatment of pulmonary tuberculosis.

Acting on this suggestion, I imported some of the salt from Messrs. Smith, Stanistreet and Company, of Calcutta, India. A 3 per cent solution in sodium citrate was prepared, placed in ampules of 2 mils each and sterilized in an autoclave. The contents of the ampules were given intravenously. One injection was given each week. Reactions indicated by dizziness, chills and rise of temperature have been noted in the cases treated for leprosy. On this account I hesitated in repeating the injections at shorter intervals than once in seven days except in the 3 cases noted in the case reports.

In the report on the leprosy cases, improvement was manifested by a reduction in the duration of the reacting parts and gradual absorption of the nodules. Usually fever was present for several days. Broken down bacilli from the tubercular deposits were noted.

In the hope that a somewhat similar reaction and subsequent improvement might be obtained in pulmonary tuberculosis, I treated 10 patients from my service at the County Hospital and at the Chicago-Winfield

[1] Read at the March, 1920, meeting of the Robert Koch Society of Chicago.

Sanatorium. The patients were not advised that a new cure for his disease was being used. They were told that the medicine was being given to eradicate their anaemia. By so doing, I felt that I would do away with the possibility of what has been termed a physchological improvement, and could note the true drug value as indicated by relapse to the condition that obtained previous to treatment.

CASE REPORTS

Case 1. E. M., an adult woman with moderately advanced tuberculosis. She had a steady afternoon temperature of 100° to 102°F. The sputum showed numerous tubercle bacilli. She received ten injections over a period of ten weeks. She complained of slight dizziness and some local pain after each injection. After the tenth injection she still showed as many tubercle bacilli as before the institution of the treatment. Her physical findings were more marked. The patient is still living but her general condition is very poor.

Case 2. D. R., an adult male with a moderately advanced pulmonary tuberculosis. His afternoon temperature ranged from 98.6° to 100°F. The sputum showed from 20 to 30 tubercle bacilli to a field. He had no reactions with any of the ten injections given at intervals of one week. At the end of this time he did not show any improvement either in his physical findings or in the number of bacilli in his sputum.

Case 3. F. W., an adult male with a bilateral apical tuberculosis. His afternoon temperature was usually normal. His sputum showed from 3 to 5 tubercle bacilli to the field. He did not show any improvement after his ten injections either in his physical findings or the number or characteristics of the bacilli in the sputum.

Case 4. C. Y., an adult male who had been ill for a period of one year. He had a tuberculous lesion of the right upper lobe. His sputum showed from 0 to 1 bacillus to a field. No change was noted in either the lung findings or in the bacillary content of the sputum.

Case 5. S. B., an adult female who developed tuberculosis after an attack of the "flu" a year ago. She had an acute bilateral upper lobe tuberculosis. Her sputum was strongly positive. Her temperature ranged from 98.6° to 100°F. Following ten weekly injections, a physical examination revealed a marked extension of her disease.

Case 6. J. C., an adult male of twenty-seven. He had an acute involvement of his entire right lung. He had had repeated small pulmonary hemorrhages. His sputum was positive and he had a constant afternoon elevation of temperature. In seven weeks he received ten injections. No improvement in physical signs, sputum or temperature was noted.

Case 7. C. M. A., young girl of twenty with an active lesion of the left apex. Her sputum showed 1 to 2 bacilli to the field. Her afternoon temperature was normal. Ten injections over a period of ten weeks apparently were without good results inasmuch as neither the lung condition nor the sputum findings were changed.

Case 8. J. W., an adult male with a bilateral moderate advanced tuberculosis. He had innumerable bacilli to every field. The X-ray findings confirmed the physical findings. No improvement was noted either in his lung condition or in his sputum findings after ten weekly injections. Two months after his last injection he had a very severe pulmonary hemorrhage.

Case 9. J. S., an adult male with a bilateral upper lobe involvement. His sputum showed 2 to 3 bacilli to a field. No change of any kind was noted after ten injections covering a period of eight weeks.

Case 10. I. L., an adult male admitted to the hospital as a far advanced case. He had an involvement of the entire right lung and the upper lobe of the left. Numerous cavities were present in both lungs. These findings were in accordance with the X-ray examination. He was given a weekly injection. With each treatment he had an elevation of temperature of one degree and also complained of a transient dizziness. Three days after his ninth injection he died as the result of a tuberculous bronchopneumonia.

SUMMARY

It is to be noted that with the exception of two cases, the injections were not followed by reactions of any type.

No patient showed a change for the better in his physical findings.

No sputum changes from positive to negative were noted.

That while the number of cases cited is small, I am inclined to the belief that sodium gynocardate "A" is without value as a therapeutic agent in the treatment of pulmonary tuberculosis.

SECONDARY INVADERS OF TUBERCULOUS LUNGS

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The prominence given to secondary infections of the lungs, as impressed by bacteriological findings in our army hospitals during the measles and pneumonia epidemics, and later, all over the country and abroad during the pandemic of influenza, has largely been directed toward the haemolytic streptococcus. The importance of various pathogenic organisms in tuberculous lungs was stressed years ago by many writers. Lartigau (1) and Prudden (2) give references to this earlier work. The latter injected streptococcus pyogenes intratracheally into rabbits which had received B. tuberculosis by the same route and produced cavities in practically all of them; the controls injected with B. tuberculosis alone showed only caseous consolidation. From his experiments, Prudden "emphasizes the importance of definite and intelligent measures for warding off complicating lesions by scrupulous attention to hygiene and sanitation, and especially the avoidance, in ways suggested by our modern notions of cleanliness, of common sources of aerial infection." At the same time Fraenkel and Troje, and Baumgarten tried to minimize the importance of these secondary invaders. "It is the belief at present that the formation of a cavity is due in large part to the presence of secondary infections with the various pus-producing organisms. These organisms produce a liquefying necrosis of the caseous area and thus hasten their breaking down" (Norris and Landis (3)).

The early workers found in the cavities and caseous areas of a large number of cases an organism which they called streptococcus pyogenes; but the pneumococcus was a frequent invader, and the surprising thing in our work has been the very low percentage of the latter. It was found but three times. It is not to be expected, however, that the same organism will be the principal secondary invader of tuberculous lungs in all sanatoria, for the great variety of organisms associated with the pneumonias following influenza has been striking.

The autopsies, in the course of which these cultures were taken, were performed on young soldiers at U. S. A. General Hospital 19, Oteen,

North Carolina, from January to early September, 1919. Observers, who had been familiar with the pathology of tuberculosis for years, frequently remarked on the great amount of consolidation, the voluminous, firm appearance of the lungs, the large size and the number of cavities, and the enormous amount of pus found in them and in the trachea. In the negroes, especially, these features were noticeable; and practically all of the colored men, who made up fully 50 per cent of the autopsies discussed here, came from one ward of very sick men. That acute infection was occurring is shown by the fact that 13 empyemata are considered in this series, 10 of which were complicating pulmonary tuberculosis. In 2 of these there was rupture of the lung, 1 being multiple. The evidence of acute infection of the lungs, superimposed on a tuberculous process, was more evident during the winter and spring months, during which time streptococcus haemolyticus was more frequently found. This organism was found in the throats of 66 per cent of infirmary ward patients. It seems hardly necessary to say that the carrier state assumes a very great importance in patients with a chronic cough and sputum, such as practically all of these men had.

Cultures were taken at nearly every autopsy from the lungs, especially from cavities, caseous and gray consolidated areas, and from the heart's blood and various exudates. The materials were streaked on blood agar plates and planted in broth. Streptococcus haemolyticus was identified by its chain formation and principally by its small rounded colony surrounded by a wide zone of haemolysis, strikingly so in these cultures, with no apparent greening. An attempt was made to identify all organisms as far as it was possible in the busy routine. The findings of Pfeiffer's bacillus were not accepted until the small Gram negative bacillus, which grew in typical colonies on blood agar, failed to grow on plain agar in twenty-four hours. Greening colonies were always tested for solubility in bile.

This review covers the bacteriological findings in the 77 cases which were cultured from 90 consecutive autopsies. Cultures were made from 56 lungs. Streptococcus haemolyticus was found pure 9 times, with Pfeiffer's bacillus alone twice, with Pfeiffer's bacillus and other organisms 4 times, and with various other organisms 17 times. However, of these 56 lungs cultured, only 52 were tuberculous. Pfeiffer's bacillus was found pure twice and with organisms other than streptococcus haemolyticus twice. Staphylococcus aureus was found 12 times, thrice pure; and Staphylococcus albus 15 times, always with other organisms.

Of the 4 nontuberculous lungs cultured, one showed no growth, one haemolytic streptococcus pure, one Streptococcus haemolyticus with B. coli and one M. catarrhalis with B. coli. Table 1 shows the more important organisms found in the lung and the number of times they were found pure, and with other organisms. By "pure" is meant that only one type of organism was found in the various lung cultures, whether they were taken from cavity, caseous area, or exudative area of caseous broncho-pneumonia, or from all of these, as many were.

TABLE 1

The more important organisms cultured from lungs

S.H. pure	9
S.H. and B.I.	2
S.H., B.I. and others	4
S.H. and others than B.I.	17
B.I. pure	2
B.I. and others than S.H.	2
S.Au. pure and mixed	12
S.Al. pure and mixed	15

S.H., Streptococcus haemolyticus; B.I., Bacillus influenzae (Pfeiffer); S.Au., Staphylococcus aureus; S.Al., Staphylococcus albus; G + B, Gram positive bacillus; G − B, Gram negative bacillus; N.H.S., Streptococcus non-haemolyticus; S.V., Streptococcus viridans.

TABLE 2

Cultures of tuberculous cavities

S.H. pure	7
S.H. and B.I.	2
S.H. and others	11
B.I. pure	2
B.I. and others than S.H.	3
S.Au. pure	4
S.Au. and others	8
S.Al. pure	1
*Others	18

* These include pneumococcus type II once, Streptococcus viridans once, haemolytic streptococcus three times, M. catarrhalis once, Gram negative bacillus twelve times.

These autopsies were all performed on young soldiers and the number and the size of cavities in their lungs were remarkable. Many of these were full of a thick pus, often mucoid in character. It was notable that the streptococcus haemolyticus was found more commonly in these cavities in the winter and spring months. In fact, the same remark applies to all of the cultures taken from the various sources. Table 2 shows the results of cultures of 37 cavities in 25 cases.

The tuberculous process in the lungs of these soldiers spread remarkably throughout these organs and the caseous bronchopneumonic areas, usually confluent, were notable in almost every case. An attempt was made to culture the caseous grayish yellow portions by inserting a fine loop just under the seared surface of these areas. Table 3 shows the results of these cultures in 40 cases.

Gross and microscopic evidence of acute pneumonia was seen in a number of these lungs. Cultures were sometimes taken from consolidated lobules showing gray hepatization and in other cases from drops of pus which could be expressed from the lung. Table 4 shows the results of these cultures.

TABLE 3

Cultures of caseous areas of caseous bronchopneumonia

S.H. pure	13
S.H. and others	6
S.H. and B.I	5
S.Au. pure	4
S. viridans	2
Pneumococcus Type IV	1
S.Al. (haemolytic pure)	1
No growth	10
*Others	12

* These include S.Al. (non-haemolytic) four, B. coli twice, diphtheroid bacillus once, anhaemolytic streptococcus once, undetermined four.

TABLE 4

	GRAY AREAS	EXPRESSED PUS
S.H. pure	4	2
S.H. and B.I	—	1
S.H. and others	1	1
B.I. and others	1	1
Pneumococcus Type IV	1	—
S.Al	1	2

During the winter and spring months there was nearly always so much glairy pus in the trachea that, in removing both lungs together, it was necessary to clamp it to prevent spreading the pus over the cadaver. The cultures in fifteen cases were taken with a loop of pus from the lumen of the trachea where it was transected at the apex of the thorax. The results are interesting enough to give in detail: Streptococcus haemolyticus pure 2, with Pfeiffer's bacillus alone 1, with Staphyloccocus albus

alone 1, with a Gram negative bacillus alone 1, with Staphylococcus albus and Pfeiffer's bacillus 1, with Pfeiffer's bacillus and pneumococcus type III 1; haemolytic Staphylococcus albus pure 1; Staphylococcus aureus pure 1; Streptococcus viridans pure 1; pneumococcus type II and Streptococcus viridans pure 1; pneumococcus type II and Staphylococcus aureus 1; and 2 contaminated cultures.

Empyema was found in 10 cases showing pulmonary tuberculosis and in 3 cases in which the lungs showed no gross tubercle formation. Of the tuberculous cases 5 had pure haemolytic streptococcus in the pleural

TABLE 5

CULTURES FROM	HEART BLOOD	PERICARDIAL FLUID
S.H. pure	9	8
S.H. and B.I	1	—
S.H. and S.Au	3	2
S.H. and others	4	5
B.I. and S.Al	1	—
S. viridans	1	—
Non-haemolytic streptococcus	1	2
S.Al	6	1
S.Au. and pneumococcus Type II	—	1
S.Au. pure	1	1
No growth	12	22
*Undetermined	16	—

* Usually Gram negative bacilli, not routinely studied.

pus, and of the non-tuberculous 2. Staphylococcus aureus alone was the infecting organism in 1 of the tuberculous cases associated with empyema. In addition 19 cultures were taken from pleural effusions, serous and sero-fibrinous. Streptococcus haemolyticus was found alone in 8, no growth occurred in 3 and the remainder showed staphylococci or Gram negative bacilli.

Cultures were taken from the heart blood in 55 cases and from the pericardium in 52 cases. The results are shown in table 5. These materials were put into broth, and the next day transferred to blood agar plates and further studied when necessary. The finding of Pfeiffer's bacillus twice in the heart blood, once with Streptococcus haemolyticus and once with Staphylococcus albus, is notable. The Streptococcus viridans was cultured only from the heart blood of the case in which it was found. Streptococcus haemolyticus was found once with an anhaemolytic streptococcus which was in the pericardial fluid. In the autopsy

TABLE 6

Organisms in lungs other than B. tuberculosis

AUTOPSY	STREPTOCOCCUS HAEMOLYTICUS	STAPHYLOCOCCUS AUREUS	STAPHYLOCOCCUS ALBUS	BACILLUS INFLUENZAE	NON-HAEMOLYTIC STREPTOCOCCUS	STREPTOCOCCUS VIRIDANS	OTHERS OR UNDETERMINED	REMARKS
15			+				Pneumococcus IV (mouse); B. diphtheriae	Tuberculosis of lungs; acute bronchitis; central pneumonia; red hepatization
16			+			+	Pseudodiphtheriae B., Pneumococcus IV; G − B	Tuberculosis of lungs; acute bronchopneumonia
20	+		+	+(?)				Tuberculosis of lungs and larynx; interstitial pneumonia (purulent)
21	+				+			Tuberculosis of lungs; acute bronchopneumonia
24	+		+	+				Tuberculosis of lungs (caseous pneumonia), larynx
25	+							Tuberculosis of lungs. Acute mediastinitis and pericarditis
(26)								Empyema, interlobar abscess; acute bronchitis; collapsed lung
(27)	+						G + dark green, haemolyzing	Mitral stenosis; decompensation; infarcts of lung; acute bronchitis

30	+			+				Tuberculosis of lungs and pleura; empyema. Perforation of lung
31		+			+		G – B	Tuberculosis of lungs. Acute bronchopneumonia
32		+ (Contamination)						Tuberculosis of lungs; pleura; miliary
33			+			+	B. Friedlander in smears (?); G – B haemolytic	Tuberculosis of lungs, kidney, larynx
(34)	+						G – B	Acute empyema; acute pericarditis; acute bronchitis
36	+						G – B	Tuberculosis of lungs; miliary
37	+						G – B	Tuberculosis of lungs; liver; bronchi
38	+							Tuberculosis of lungs; miliary; larynx; acute lobular pneumonia
40	+	+ (Haemolytic)						Tuberculosis of lungs
41							G – B	Tuberculous meningitis; lungs; pleura; Interlobular empyema
43	+							Tuberculosis of lungs; haemothorax
44	+							Tuberculosis of lungs; miliary; acute bronchopneumonia

TABLE 6—*Continued*

AUTOPSY	STREPTOCOCCUS HAEMOLYTICUS	STAPHYLOCOCCUS AUREUS	STAPHYLOCOCCUS ALBUS	BACILLUS INFLUENZAE	NON-HAEMOLYTIC STREPTOCOCCUS	STREPTOCOCCUS VIRIDANS	OTHERS OR UNDETERMINED	REMARKS
47	+		+				G – B	Tuberculosis of lungs; larynx, empyema; bronchitis
48	+						G – B	Tuberculosis of lungs; empyema; peritonitis
49	+							Tuberculosis of lungs; larynx; acute bronchitis
50	+		+				G – B	Tuberculosis of lungs; larynx; acute bronchitis
51				+ (Profuse)				Tuberculosis of lungs; larynx
52	+						G – Micrococcus haemolytic	Tuberculosis of lungs; bowel; kidney
53	+							Tuberculosis of lungs; acute bronchopneumonia; fibrino-purulent pleurisy
54	+			+				Tuberculosis of lungs; peritoneum
55			+ (Haemolytic)	+				Tuberculosis of lungs; acute bronchitis
56			+ (Haemolytic)					Tuberculosis of lungs and bowel
57	+		+ (Haemolytic)					Tuberculosis of lungs; and larynx. Empyema

58	+		+ (Haemolytic)					Sero-fibrinous pleurisy and pericarditis. Tuberculosis of lungs and larynx
60								Tuberculosis of lungs and larynx
61	+	+						Tuberculosis of lungs. Acute bronchitis; acute interstitial pneumonia
62	+							Tuberculosis of lungs, larynx, pericardium. Sero-fibrinous pleurisy
65	+						G. — diplobacillus	Tuberculosis of pleura; lungs (slight) sero-fibrinous pleurisy
66		+						Tuberculosis of lungs; pleura; fibrino-purulent pleurisy
68	+		+	+				Tuberculosis of lungs; acute bronchitis
71				+				Tuberculosis of lungs; adrenal
72		+	+ (Haemolytic)			+	Gram — B.	Tuberculosis of lungs; prostate. Fatal haemorrhage
73		+		+			Colon like B.; Diphtheroid B.	Tuberculosis of lungs; spleen

TABLE 6—*Concluded*

AUTOPSY	STREPTOCOCCUS HAEMOLYTICUS	STAPHYLOCOCCUS AUREUS	STAPHYLOCOCCUS ALBUS	BACILLUS INFLUENZAE	NON-HAEMOLYTIC STREPTOCOCCUS	STREPTOCOCCUS VIRIDANS	OTHERS OR UNDETERMINED	REMARKS
74		+					Pneumococcus Type II; Streptococcus mucosus	Tuberculosis of lungs; larynx; prostate; acute bronchitis
75	+ (Slightly haemolytic)	+					Gram − B	Pyopneumothorax. Collapse of lung; fibrinous pleurisy; tuberculosis of lungs
76		+ 3 colonies (Contamination?)					G − B G + B	Tuberculosis of lungs; haemorrhage; caseous peritonitis
77	+			+		+		Tuberculosis of lungs; acute tracheitis and bronchitis. Pneumococcus II, S.H. and B.I. in tracheal pus
79	+							Tuberculosis of lungs
80	+ (On left)							Tuberculous meningitis; miliary of lungs
82								Tuberculosis of lungs and larynx
86	+	+ (Profuse)					G − B	Tuberculosis of lungs; acute bronchitis
(89)							M. catarrhalis	Acute empyema; gangene of lung with rupture

93	+						G – B	Empyema. Tuberculosis of lungs
95		+						Caseous pleurisy. Tuberculosis of lungs and peritoneum
100					+		G – B	Tuberculosis of lungs. Miliary
101		+					G – B	Tuberculosis of glands; lungs; pleura; pericardium
102								Tuberculosis of bowel, lungs
103		+						Tuberculosis of glands, lungs, pleura

in which Pfeiffer's bacillus was cultured with Streptococcus haemolyticus from the heart blood, they were also found together in a cavity in the lung, in a caseous area, and in a drop of pus expressed from the lung. In this case haemolytic streptococcus was found pure in the empyema pus. In an interesting case of Staphylcocccus aureus septicaemia in which the staphylococcus alone was found during life, a few colonies of haemolytic streptococcus were found with the Staphylococcus aureus from the heart blood at autopsy. This man also had pulmonary tuberculosis and acute tricuspid endocarditis.

A survey was made in some of the infirmary wards which contained the sickest patients and of some of the patients on arrival at the receiving wards. Blood agar plates were inoculated with swabs from the throats in 346 instances, and with washed sputa from the same group 343 times. The swabs gave 231 positive haemolytic streptococcus cultures, or 66 per cent, and the sputa 202, or 58 per cent. Of the swabs, 22 were "repeats" made a month later and 2, which were negative in the first instances were again negative, while 19 which were negative the first time were now positive. Of negative sputa, 16, which were re-cultured, were now all positive for the streptococcus. This small number, which included most of the negative cases on the first culturing in three wards, offers good evidence of bed-to-bed infection with the streptococcus. It was thought that the patients in the hill, or convalescent, wards would not harbor this organism to the same extent, but this expectation was not borne out, for, of these patients in one ward, the swabs gave 19 positive and 2 negative, and the sputa 16 positive and 4 negative results. But their plates did not show as much haemolysis as those inoculated with material from 1–3, a ward of very sick colored men. Neither was the expectation that there would be marked differences between the swab and the sputum results borne out. Haemolytic streptococcus was carried by a large number of patients to this hospital, for of 138 patients arriving here, swabbed at the receiving ward on entrance, 97 or 70.2 per cent, were positive, and of their sputa, 88, or 63.7 per cent, were positive for the streptococcus.

In attempting this survey of the prevalence of the streptococcus in a carrier state in these patients, it was hoped that it might be possible to segregate, in at least a few of the "sickest" wards, the carriers from the non-carriers. This idea did not have a fair trial, and, as might be anticipated, it had no apparent effect on the frequency of this organism at autopsies. Bed-to-bed infection was noticed.

The various bacteria cultured from the lungs and the principal lesions in each autopsy are recorded in table 6. With only a few exceptions the lungs not cultured were X-rayed in the inflated state immediately after removal, and were then fixed intact. As it would have been manifestly impossible to know exactly what areas would be cultured by puncture of these lungs, their bacteriology was neglected. The organisms noted as Gram negative bacilli resembled B. coli. As it was desirable to perform these autopsies before the staff, and as many of the deaths occurred during the night, eight and ten hours often intervened between death and post mortem examination. The bodies were kept in a refrigerator. Practically all of the diagnoses mentioned as "miliary tuberculosis" were localized, as in liver, and infection had occurred recently before death. When only one positive sign is seen after the autopsy number (A), the organism occurred pure and was usually cultured from several lesions in the lung. Autopsy 62 took place on May 2, 1919, and it will be noticed that most of the streptococci were found before that date. The enclosure of the autopsy number in parenthesis denotes that in this case the lung was not tuberculous.

CONCLUSIONS

Streptococcus haemolyticus was found in a large percentage of the throats and, from the finding of them in washed sputa, probably deeper in the respiratory tract of these tuberculous soldiers. It spreads, as is well known, from carrier to non-carrier. It is frequently found at autopsy in the caseous areas and cavities of their lungs, and in various exudates, which are evidence of acute inflammations. It and other pathogenic organisms are probably factors in the cavity formations which were very frequent in these autopsies, for this organism was often found in the caseation which precedes cavitation.

The practice in military hospitals for the tuberculous of treating large numbers of patients in wards emphasizes again the importance of mixed infections of the lung and the necessity of combating it.

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REFERENCES

(1) Lartigau, A. J.: Twentieth Cent. Pract. Med., 1900, xx, 60.
(2) Prudden, T. M.: N. Y. M. J., July 7, 1894, 1.
(3) Norris, G., and Landis, H. R. M.: Diseases of the chest, 303.

AN EXPERIMENTAL STUDY OF THE ACTION OF ULTRAVIOLET LIGHT ON THE INTRADERMIC TUBERCULIN REACTION

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Although cutaneous sensitiveness to the ultraviolet ray has long been recognized, little attention has been paid to this in experimental work. Protection afforded by the shutting out of white light in the handling of smallpox (1) has been alleged to reduce the extent of skin lesions and degree of fever and almost to prevent subsequent scarring. Likewise skin manifestations of pellagra (2) may have a strong dependence upon light for their origin. In work under tropical sunlight, Sellards (3) briefly mentions results in local anaphylaxis, observing changes due to the influence of the sun rays upon the redness and edema of skin reactions.

Karczag (4) studied the effect of sunlight on the allergy of albino and pigmented tuberculous guinea pigs. His findings are interesting enough to mention in detail: (1) The inguinal glands after infection were larger in white pigs than in pigmented ones; this difference did not vary with exposure to light until after seventeen days, when those exposed to light showed larger glands than the unexposed. (2) Allergy, in albinos exposed to light, judged by the skin tuberculin reaction, was greater than in pigmented pigs, but as the disease advanced it diminished in the former and increased in the latter. (3) In comparison with the unexposed, those exposed to light showed greater allergy; and as the disease progressed, the former lost much more than the latter. (4) In animals with advanced disease that had previously avoided light it was found that the allergy did not increase with exposure. (5) The white animals finally showed a greater mortality than the pigmented. Römer (5) noted differences in intracutaneous tuberculin reactions between white and pigmented guinea pigs. The albinos after twenty-four hours showed intense redness, resembling blood extravasation, while the colored pigs reacted chiefly with swelling and this only after forty-eight hours.

The following experiments were undertaken to note any possible effects of the ultraviolet light, radiated from the mercury vapor-quartz lamp, known as the "Alpine Sun Lamp," upon the intradermic tuberculin reaction in tuberculous guinea pigs; as well as any variation in skin reaction to be got from the injection of tuberculin which had been previously exposed to the ultraviolet rays, and the results of similar intradermic injections and ultraviolet exposures in tuberculous patients.

The quartz-light emits mostly ultraviolet rays and very few of the other rays. "The spectrum of sunlight is a continuous one, reading at low altitudes up to λ 300$\mu\mu$. The spectrum of the quartz-light is interrupted; it extends much further into the ultraviolet than the sunlight spectrum. Around λ 200$\mu\mu$ it contains bands of far greater intensity. These extreme ultraviolet rays set up irritation in substances that are otherwise unaffected by daylight." (11).

EXPERIMENTS

Twelve guinea pigs were inoculated intraperitoneally with 0.01 mgm. of a suspension of living human tubercle bacilli (known at the Saranac laboratory as H37). Three weeks later the intradermic test was performed as follows:

1. Controls: Three pigs shaved on right and left sides over an area about 6 by 6 cm. in size. Right side: Intradermic test with 0.1 cc. containing 0.001 gram O.T. Left side: Intradermic test with 0.1 cc. of physiological saline solution. Readings made in twenty-four, forty-eight, and seventy-two hours

2. Three pigs similarly shaved. Right side: First exposed to the ultraviolet light through the smallest diaphragm (40 mm. diameter) for ten to fifteen minutes at a distance of 3 inches; then after one-half hour or six hours, intradermic injection of 0.1 cc. containing 0.001 gram O.T. into exposed areas. Left side: Intradermic injection of 0.1 cc. containing 0.001 gram O.T. (No lamp exposure). Readings made in twenty-four, forty-eight and seventy-two hours.

3. Three pigs similarly shaved. Right side: Intradermic injection of 0.1 cc. containing 0.001 gm. O.T.; then the inoculated area exposed immediately or in two hours to the lamp for ten to fifteen minutes at a distance of 3 inches. Left side: Intradermic injection of 0.1 cc. containing 0.001 gram O.T. (No lamp exposure). Readings made in twenty-four, forty-eight and seventy-two hours.

4. Old tuberculin, so diluted in 0.85 per cent salt solution as to have 1 cc. contain 0.01 gram, or 0.1 cc. contain 0.001 gram, poured into an open sterile Petri dish and the whole dish with tuberculin exposed uniformly to the lamp

for three-quarters to one hour at a distance of 2 feet in a closed room, barring the entrance of any daylight. Three guinea pigs shaved as before. Right side: One-tenth cubic centimeter of the exposed tuberculin dilùtion injected intradermally. Left side: One-tenth cubic centimeter non-exposed, diluted O.T. injected intradermally. Readings made in twenty-four, forty-eight and seventy-two hours.

5 and 6. Second and third sets of guinea pigs used for repeating tests.

7. Patients with a small skin area on the forearm, exposed to the lamp for five to seven minutes at a distance of 3 to 10 inches, through a diaphragm about 3 by 4 inches; 0.1 cc. containing 0.0001 gram O.T. given intradermally, both before and after exposure to the lamp. Finally, tuberculin exposed to the lamp as in 4 given intradermally to patients.

REMARKS ON ANIMAL EXPERIMENTS

In a first set of guinea pigs, the intradermic tests were performed three weeks after the infection; and the results as shown below were not uniform enough to permit conclusions. Accordingly, a new set of guinea pigs (5) was inoculated subcutaneously into the groin with 0.1 cc. of a suspension of living human tubercle bacilli (H37) which on microscopic examination showed three to four bacilli to a field; and these animals were given the intradermic test ten to fourteen days after infection. Their results are given below, but were upset by an epidemic of chronic bronchopneumonia which killed off the majority. A third set of six guinea pigs (6) was inoculated intraperitoneally with a suspension of 0.01 mgm. of living human bacilli (H37) and were tested intradermally two weeks after injection, and their results are tabulated below.

RESULTS OF EXPERIMENTS

In the pigs, reacting to the control intradermic test, the induration appears as thickened skin of a bluish green color, surrounding a central pallor and this gradually fades outward toward a zone of erythema. The area of erythema is easily distinguished from the surrounding tissue. Some of these reactions did not disappear in two weeks. The difference in extent of the reaction between control areas and those exposed to sunlight appeared in many instances as a decreased induration and erythema on the exposed side, although this result was not uniform enough to make it an expected result. Only very rarely, however, did the tuberculin reaction on the exposed side surpass that on the unexposed, and this was in animals only.

In estimating the intensity of the skin reaction, Krause (6) offers a scale of reaction as follows: "Hyperemia; hyperemia and induration; hyperemia, induration and necrotic center; hyperemia, induration and necrotic-hemorrhagic center. Any marked hyperemia after twenty-four hours without induration is a rarity. An atypical reaction is induration with very slight hyperemia or induration with blanched skin." He recorded his induration by one plus, two plus and three plus.

In the earlier of these experiments the first few animals were examined before twenty-four hours to observe any hastening of the appearance of the skin reaction, and as this did not occur it was not looked for again. However, Hollmann (7) published some work to the effect that light did have a hastening influence in this way.

The erythema due to the tuberculin reaction was frequently difficult to distinguish from the light burn. The redness due to the light generally appeared best in a few hours, although in the albino pigs it might appear immediately after exposure. To obtain a noticeable burn, the animals were exposed at least ten minutes at a distance of three inches which was the amount used for albinos. In exposing tuberculin to the light, exposure for one-half hour at a distance of 4 feet caused little change in its reacting power; but a very definite loss and occasionally absence of intradermic reaction followed the use of tuberculin that had been exposed for three-quarters of an hour or more to the lamp at the same distance. The oxidizing power of the lamp might possibly be such as to destroy proteins, or, according to Petersen's views (8), the enzyme-producing power of the tuberculin might conceivably be thus weakened.

That the ultraviolet rays can definitely affect proteins has been shown by Schanz (11). He exposed to light the albumen of the lens of the eye, egg albumen and serum albumen. With all three he was regularly able to bring about changes. He concluded that "in dialyzed egg white solutions the easily dissolved egg albumen is changed by light into a substance which is dissolved with great difficulty." By further study of the absorption spectra, he showed that it was the ultraviolet ray of the light that caused these changes. In addition he exposed a large number of organic substances to light, such as acetone, formaldehyde, acetaldehyde, lactic acid and potassium iodide,—substances whose solutions were clear and colorless; and he found that the most intense change occurred in those which absorbed the ultraviolet rays most. These organic substances in the presence of quartz-light were broken up into their elements and radicles.

The first experiments were carried out in 1916 and a similar set repeated in 1919. The recent results closely approached those obtained before and are, therefore, not tabulated. The difference between exposed and unexposed sides was possibly less than in the animals previously used. However, a decreased reaction on the exposed side was a fairly common result.

RESULTS OF TESTS ON PATIENTS

In addition to the animal experiments, the intradermic test was performed on five patients who had acquired sunlight pigmentation (tanning). One forearm, well tanned, received 0.1 cc. containing 0.0001 gram O.T. intradermally; and the other, unpigmented, received a similar dose. The result showed little difference other than a slight diminution in extent of the reaction on the pigmented side.

Five other patients received an intradermic injection of 0.1 cc., containing 0.0001 gram O.T., into both forearms; and during the following twenty-four hours the one side was shielded from diffuse daylight and the other exposed to it. In these cases absence or presence of light did not appreciably affect the reactions.

In the patients tested in 1916 and 1919 we noted that the exposed area usually showed a decreased reaction in comparison with the unexposed. This seemed to be so whether or not the patient showed a marked burn. In severe burns the reaction to O.T. will be masked by edema and redness. Erythema due to the burn was not easily differentiated from that caused by the tuberculin reaction itself, although on pressure the redness due to the burn, after disappearing, returned almost immediately while the erythema from the tuberculin reaction returned much more slowly. On injecting tuberculin into the arm, following the exposure there was usually a more rapid disappearance of the tuberculin with less formation of a bleb than in the controls. In two instances the reaction on the exposed area was simply delayed, appearing definitely twenty-four hours after that on the unexposed side and equalling the latter in extent at ninety-six hours.

There seemed little difference in the reaction between those receiving the lamp exposure before and those receiving it after the tuberculin injections; therefore it would not suggest that the lessened reaction on the exposed area as compared with the control was due to the direct action of the ultraviolet ray on the injected tuberculin. It may be

possible that this diminished or delayed reaction on the exposed area is due merely to the hyperemia caused by the exposure rather than to a definite local tissue change, since it would seem highly improbable to obtain the latter after such short light exposures. Definite local tissue changes might be more likely to occur when tanning has taken place, but in the few pigmented patients used there was only a slight decrease of reaction in the burned area.

Following more recent views on the specific power of the skin to produce antibodies in response to local irritation, could we not here believe that there is an increased antibody formation as a result of ultraviolet stimulation? Wichmann (9) has published observations of rapid healing of internal and external tuberculosis after the appearance of tuberculids. He believed this due to the large number of antibodies suddenly thrown out by the skin and tried to show this by histologic studies. In accordance with this theory we find also that the percutaneous method of applying tuberculin is gradually claiming more adherents abroad.

In order to determine whether sharply defined differences in reaction can be obtained by the use of minimal reacting doses of tuberculin, further experiments will be carried out. Light may have influenced the reaction, but not enough to make itself evident when sufficient excess of tuberculin was present to produce a reaction. Römer (10) found that the most susceptible guinea pigs reacted intradermally to 0.000,002 gram tuberculin. He graduated his solutions in tenths so that he did not try doses between 0.000,000,2 gram and 0.000,002 gram.

Tuberculin exposed to the lamp as mentioned before under animal experimentation was also injected intradermally into the arms of ten patients and showed a definitely lessened reaction and in some instances absence of same, while the control gave marked reactions (figures not charted).

This action on tuberculin might be one of the means by which the ultraviolet ray combats superficial tuberculosis.

SUMMARY

1. The intradermic tuberculin test in guinea pigs and patients often gives a reaction of lessened extent when the injected area is treated locally with short exposures of the ultraviolet rays either before or after injection. Recently tanned skin also gives a slightly lessened reaction.

2. Tuberculin exposed for a sufficient length of time (forty-five minutes at a distance of 2 feet) to the ultraviolet rays loses markedly, and at times entirely, its power to cause intradermic reactions.

The writer expresses his gratitude to Dr. Edward R. Baldwin for his interest and suggestions.

REFERENCES

(1) Reyn, cited by Sellards: Finsenbehandlung. Berlin, 1913.
(2) Raubitscheck: Deutsch. med. Wchnschr., 1912, xxxviii, 2169. Wien. klin. Wchnschr., 1910, xxiii, 963. Centralbl. f. Bakt., 1910–1911, Orig., 1st Abt., lvii, 193.
(3) Sellards, A. W.: J. Med. Res., 1918, xxxviii, 293.
(4) Karczag, L.: Beitr. z. Klin. d. Tuberk., 1919, xli, H. 1 & 2.
(5) Römer, P., cited by Karczag (4).
(6) Krause, A. K.: J. Med. Res., 1916, xxxv, 1.
(7) Hollmann, H.: Beitr. z. klin. d. Tuberk., 1919, Supplement Bd. viii, 29.
(8) Petersen, W. F.: J. Med. Res., Feb., 1916.
(9) Wichmann: Zeitschr. f. Tuberk., 1919, xxx, H4.
(10) Römer, P.: Beitr. z. Klin. d. Tuberk., 1909, xiv, 1.
(11) Schanz, F.: Licht und Lichtbehandl. Strahlenther., 1919, ix, H. 2.

PROTOCOLS OF EXPERIMENTS

SKIN REACTIONS ON GUINEA PIGS

First set: October 31, 1916. Infected with 0.01 mgm. of living tubercle bacilli (H37) intraperitoneally.

1. Controls: three pigs.

		Right: 0.001 gram. O. T. intradermally		Left: physiological saline	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	15 x 17 mm.	18 x 22 mm.	0	0
	48 hours	10 x 12 mm.	15 x 30 mm.	0	0
	72 hours	10 x 12 mm.	0	0	0
No. 2	24 hours	0	3 x 5 mm.	No reaction	
	48 hours	2 x 4 mm.	10 x 12 mm.	No reaction	
	72 hours	4 x 8 mm.	12 x 14 mm.	No reaction	
No. 3	24 hours	6 x 10 mm.	10 x 20 mm.	No reaction	
	48 hours	4 x 12 mm.	10 x 12 mm.	No reaction	
	72 hours	2 x 6 mm.	6 x 8 mm.	No reaction	

2. Three pigs. Exposure to the lamp for twelve minutes at 3 inches followed by 0.001 gram O.T. intradermally in one-half hour.

		Right: lamp exposure, followed by O. T.		Left: O. T. alone	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	10 x 16 mm.	16 x 18 mm.	24 x 32 mm.	30 x 40 mm.
	48 hours	14 x 22 mm.	16 x 22 mm.	15 x 30 mm.	30 x 40 mm.
	72 hours	14 x 16 mm.	16 x 18 mm.	10 x 25 mm.	24 x 32 mm.
No. 2	24 hours	12 x 14 mm.	5 x 10 mm.	10 x 12 mm.	15 x 18 mm.
	48 hours	3 x 6 mm.	8 x 10 mm.	8 x 10 mm.	10 x 12 mm.
	72 hours	3 x 3 mm.	6 x 6 mm.	6 x 6 mm.	7 x 8 mm.
No. 3	24 hours	12 x 13 mm.	16 x 18 mm.	10 x 12 mm.	12 x 14 mm.
	48 hours	6 x 8 mm.	10 x 12 mm.	8 x 10 mm.	12 x 12 mm.
	72 hours	4 x 6 mm.	6 x 8 mm.	7 x 10 mm.	12 x 14 mm.

Result: A rather uniform slightly lessened reaction on exposed side.

3. Three pigs, injected intradermally with 0.001 gram O.T., followed immediately by the lamp exposure.

		Right: O. T. followed by the lamp exposure		Left O. T.	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	10 x 20 mm.	10 x 12 mm.	14 x 22 mm.	30 x 30 mm.
	48 hours	10 x 10 mm.	12 x 12 mm.	18 x 12 mm.	15 x 18 mm.
	72 hours	3 x 4 mm.	0	4 x 6 mm.	22 x 26 mm.
No. 2	24 hours	3 x 5 mm.	4 x 6 mm.	0	0
	48 hours	8 x 10 mm.	6 x 8 mm.	8 x 10 mm.	3 x 5 mm.
	72 hours	4 x 5 mm.	6 x 8 mm.	10 x 12 mm.	4 x 6 mm.
No. 3	24 hours	15 x 20 mm.	18 x 22 mm.	9 x 10 mm.	0
	48 hours	13 x 14 mm.	15 x 18 mm.	6 x 15 mm.	14 x 18 mm.
	72 hours	0	7 x 10 mm.	0	20 x 30 mm.

Result: No. 1 shows diminished reaction on exposed side, but No. 2 and No. 3 do not.

4. Three pigs. Injected with O.T. which has been exposed to the lamp for three-quarters of an hour at a distance of 2 feet.

		RIGHT: EXPOSED O. T. USED		LEFT: ORDINARY O. T.	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	0	0	3 x 4 mm.	4 x 6 mm.
	48 hours	0	0	2 x 4 mm.	4 x 6 mm.
	72 hours	0	0	0	2 x 2 mm.
No. 2	24 hours	0	12 x 16 mm.	0	20 x 20 mm.
	48 hours	0	0	0	22 x 25 mm.
	72 hours	0	0	0	10 x 12 mm.
No. 3	24 hours	5 x 12 mm.	13 x 20 mm.	10 x 12 mm.	16 x 30 mm.
	48 hours	0	10 x 12 mm.	13 x 16 mm.	12 x 13 mm.
	72 hours	0	4 x 5 mm.	6 x 8 mm.	10 x 12 mm.

Result: Marked lessened reaction on the right side.

5. Second set. Infected May 12, 1917, subcutaneously with 0.1 cc. of an emulsion of tubercle bacilli, showing about three bacilli to a microscopic field. Tested intradermally May 24, 1917.

a. Controls: Three pigs.

		RIGHT: 0.001 GRAM O. T.		LEFT: SALINE	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	11 x 22 mm.	22 x 25 mm.	0	0
	48 hours	6 x 10 mm.	10 x 12 mm.	0	0
	72 hours	0	0	0	0
No. 2	24 hours	8 x 8 mm.	14 x 16 mm.	0	0
	48 hours	6 x 10 mm.	15 x 20 mm.	0	0
	72 hours	5 x 8 mm.	10 x 12 mm.	0	0

No. 3 died of bronchopneumonia.

b. Three pigs; exposed to the lamp and then inoculated intradermally with O.T.

		RIGHT: LAMP EXPOSURE, THEN O. T.		LEFT: O. T.	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	8 x 10 mm.	16 x 18 mm.	13 x 15 mm.	18 x 20 mm.
	48 hours	10 x 12 mm.	15 x 20 mm.	14 x 18 mm.	19 x 22 mm.
	72 hours	12 x 14 mm.	12 x 18 mm.	18 x 15 mm.	16 x 18 mm.

Result: Lessened reaction on exposed side. Nos. 2 and 3 died of bronchopneumonia.

c. Three pigs, inoculated with O.T. and then followed with the lamp exposure.

	Right: O. T. then lamp exposure		Left: O. T.	
	Induration	Erythema	Induration	Erythema
No. 1 24 hours	8 x 10 mm.	12 x 14 mm.	3 x 5 mm.	4 x 6 mm.
48 hours	4 x 6 mm.	15 x 20 mm.	2 x 4 mm.	12 x 16 mm.
72 hours	2 x 4 mm.	6 x 8 mm.	3 x 5 mm.	8 x 10 mm.

Result: Greater reaction on the exposed side. Nos. 2 and 3 died of bronchopneumonia

d. All three pigs died of bronchopneumonia.

6. Third set. Infected June 10, 1917, intraperitoneally with 0.01 mgm of a suspension of living tubercle (human) bacilli. Tested June 24, 1917, intradermally.

a. Control: One pig.

	Right: 0.001 gram O. T.		Left: Saline	
	Induration	Erythema	Induration	Erythema
No. 1 24 hours	11 x 22 mm.	22 x 25 mm.	No reaction	
48 hours	10 x 12 mm.	20 x 20 mm.	No reaction	

b. Two pigs, exposed to the lamp and then followed by O.T. intradermally.

	Right: Lamp exposure, then O. T.		Left: O. T.	
	Induration	Erythema	Induration	Erythema
No. 1 24 hours	4 x 8 mm.	4 x 10 mm.	4 x 6 mm.	10 x 12 mm.
48 hours	4 x 6 mm.	6 x 10 mm.	3 x 4 mm.	18 x 18 mm.
72 hours	0	5 x 9 mm.	6 x 6 mm.	12 x 14 mm.
No. 2 24 hours	10 x 18 mm.	12 x 20 mm.	8 x 10 mm.	12 x 10 mm.
48 hours	8 x 10 mm.	20 x 20 mm.	8 x 8 mm.	10 x 12 mm.
72 hours	0	14 x 14 mm.	0	0

Result: Lessened reaction on the exposed side in No. 1, but greater in No. 2.

c. Two pigs, inoculated with O.T. followed by lamp exposure.

	Right: O. T. followed by lamp exposure		Left: O. T.	
	Induration	Erythema	Induration	Erythema
No. 1 24 hours	0	3 x 5 mm.	0	10 x 12 mm.
48 hours	0	6 x 8 mm.	0	6 x 7 mm.
72 hours	0	3 x 5 mm.	0	5 x 6 mm.
No. 2 24 hours	0	10 x 12 mm.	3 x 5 mm.	12 x 20 mm.
48 hours	2 x 4 (?)	10 x 10 mm.	3 x 4 mm.	10 x 15 mm.
72 hours	0	6 x 8 mm.	2 x 3 mm.	8 x 10 mm.

Result: Lessened reaction on exposed sides.

d. Two pigs, inoculated with O.T. which had been exposed to the lamp for forty-five minutes at a distance of 2 feet.

		RIGHT: EXPOSED O. T.		LEFT: ORDINARY O. T.	
		Induration	Erythema	Induration	Erythema
No. 1	24 hours	3 x 5 mm.	8 x 10 mm.	10 x 12 mm.	10 x 25 mm.
	48 hours	6 x 7 mm.	10 x 12 mm.	4 x 10 mm.	22 x 20 mm.
	72 hours	3 x 5 mm.	6 x 8 mm.	2 x 3 mm.	13 x 15 mm.
No. 2	24 hours	8 x 10 mm.	10 x 12 mm.	12 x 14 mm.	15 x 25 mm.
	48 hours	6 x 7 mm.	7 x 9 mm.	7 x 8 mm.	10 x 15 mm.
	72 hours	8 x 10 mm.	7 x 9 mm.	10 x 12 mm.	12 x 15 mm.

Result: Lessened reaction on exposed sides.

7. Table of results in ten patients:

a. Five patients exposed their right forearms to the lamp for five minutes at a distance of 3 to 10 inches through a diaphragm of 3 by 4 inches, followed immediately or in one hour by an intradermic injection of 0.001 gram O.T., in amount 0.1 cc. Left forearm received the intradermic test with no lamp exposure.

		RIGHT: EXPOSED			LEFT: NOT EXPOSED	
		Induration	Erythema	Burn	Induration	Erythema
No. 1	24 hours	0	10 x 10 mm.		8 x 10 mm.	20 x 25 mm.
	48 hours	10 x 12 mm.	?	Marked burn	20 x 20 mm.	25 x 35 mm.
	72 hours	20 x 20 mm.	?		20 x 20 mm.	25 x 25 mm.
	96 hours	15 x 17 mm.	18 x 20 mm.		15 x 18 mm.	18 x 20 mm.
No. 2	24 hours	0	0		2 x 2 mm.	10 x 15 mm.
	48 hours	Marked burn with doubtful reaction			2 x 2 mm.	10 x 12 mm.
	72 hours				5 x 5 mm.	10 x 10 mm.
	96 hours				0	12 x 14 mm.
No. 3	24 hours	0	5 x 5 mm.		2 x 3 mm.	15 x 25 mm.
	48 hours	10 x 10 mm.	? Marked burn	Burn	0	25 x 30 mm.
	72 hours	? burn	? burn		0	15 x 20 mm.
	96 hours	4 x 6 mm.	10 x 10 mm.		0	8 x 10 mm.
No. 4	24 hours	2 x 3 mm.	10 x 12 mm.		4 x 5 mm.	22 x 35 mm.
	48 hours	3 x 4 mm.	17 x 20 mm.	Burn	5 x 6 mm.	18 x 22 mm.
	72 hours	Burn ?	Burn ?		5 x 5 mm.	15 x 20 mm.
	96 hours	0	12 x 20 mm.		10 x 12 mm.	15 x 20 mm.
No. 5	24 hours	0	0		2 x 3 mm.	7 x 7 mm.
	48 hours	0	0	Marked burn	8 x 10 mm.	12 x 13 mm.
	72 hours	0	0		10 x 10 mm.	15 x 20 mm.
	96 hours	4 x 6 mm.	0		10 x 12 mm.	18 x 20 mm.

Result: Uniformly lessened reactions on exposed arms.

b. Five patients received in their right forearms intradermally 0.0001 gram O.T. in 0.1 cc. amount, followed in one-half hour by an exposure to the lamp from five to seven minutes at a distance of 5 inches through a diaphragm 3 by 4 inches. Left forearm, received the intradermic test with no lamp exposure.

		Right: Exposed			Left: Unexposed	
		Induration	Erythema	Burn	Induration	Erythema
No. 1	24 hours	0	0	Marked	3 x 4 mm.	15 x 15 mm.
	48 hours	0	0		2 x 3 mm.	15 x 20 mm.
	72 hours	0	0		0	12 x 18 mm.
	96 hours	0	0		0	10 x 12 mm.
No. 2	24 hours	8 x 3 mm.	20 x 12 mm.		7 x 7 mm.	30 x 30 mm.
	48 hours	12 x 14 mm.	20 x 20 mm.	Slight burn	2 x 3 mm.	12 x 14 mm.
	72 hours	10 x 10 mm.	12 x 12 mm.		10 x 12 mm.	15 x 20 mm.
	96 hours	10 x 10 mm.	18 x 20 mm.		8 x 12 mm.	12 x 18 mm.
No. 3	24 hours	10 x 19 mm.	25 x 35 mm.	A deeper red than left side	10 x 10 mm.	25 x 35 mm.
	48 hours	10 x 10 mm.	15 x 20 mm.		10 x 12 mm.	20 x 20 mm.
	72 hours	3 x 4 mm.	13 x 15 mm.		4 x 5 mm.	20 x 20 mm.
	96 hours	10 x 11 mm.	15 x 16 mm.		10 x 12 mm.	16 x 18 mm.
No. 4	24 hours	0	0		11 x 10 mm.	30 x 50 mm.
	48 hours	12 x 12 mm.	16 x 18 mm.		13 x 15 mm.	20 x 25 mm.
	72 hours	10 x 10 mm.	20 x 20 mm.		10 x 10 mm.	20 x 25 mm.
	96 hours	12 x 20 mm.	16 x 30 mm.		12 x 20 mm.	16 x 32 mm.
No. 5	24 hours	0	0		10 x 10 mm.	18 x 20 mm.
	48 hours	10 x 12 mm.	15 x 15 mm.		12 x 12 mm.	30 x 32 mm.
	72 hours	8 x 10 mm.	11 x 10 mm.		11 x 10 mm.	15 x 20 mm.
	96 hours	9 x 9 mm.	11 x 12 mm.		9 x 9 mm.	11 x 12 mm.

Result: Lessened reaction on exposed side in Nos. 1, 4 and 5, but not uniformly in Nos. 2 and 3.

A CLASSIFICATION TO FACILITATE THE SELECTION OF PATIENTS FOR WORK IN A TUBERCULOSIS SANATORIUM

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The many workers in the tuberculosis field have differed greatly in regard to the amount of exercise they considered proper for the patient to take. The more radical have advocated laborious work such as road building, masonry and ditch digging, while at the other extreme are those who are strong advocates of the rest treatment with the addition of calisthenics and walking for exercise.

Recognizing physical exercise as a therapeutic measure, patients at the Municipal Sanatorium[1] are expected to perform a sufficient amount of work to insure physiological reaction on the part of the various tissues (skin, glands, muscles, etc.), which, if left dormant for a considerable time would, through their failure to functionate, retard the patient's recovery. The tasks assigned are shown in the appended charts. Every assignment made is under the direct supervision of a hospital physician who sees every patient daily. The whole question of work assignments in the sanatorium is secondary to the medical direction in the care of the patients. Work is assigned always as a therapeutic measure. It will be seen by referring to the charts, that in many instances the work assignment is nothing more nor less than an expedient, used to divert the thoughts of the patient from his physical condition to other things. Recently the literature of tuberculosis has been enriched by such terms as vocational therapy, graduated exercise, rehabilitation, occupational therapy, reconstruction, vocational education, vocational training, etc., all of which simply mean that the tuberculosis patient is expected to do some form of work.

The policy pursued at the Municipal Sanatorium since it was opened in 1906 has been one of graduated exercise in the form of work, the

[1] This paper was written as the result of experience obtained while Physician in Charge of the Municipal Sanatorium of the City of New York, Otisville, Orange County, New York.

amount and character of the latter depending on the condition of the patient.

The theory upon which this system is based is:

First. Most patients are benefited by a certain amount of exercise in the form of work because it tends to keep the various organs of the body functionating in a proper manner.

Second. It keeps the mind occupied and thus prevents them from thinking of the condition of their lungs.

Third. The fact that they are able to work tends to give them a contented spirit which is an essential factor in the treatment of tuberculosis.

Patients at the Municipal Sanatorium are expected to do from two to four hours work daily, always provided their physical condition permits; the amount depending on the judgment of the Resident Physician. If they perform four hours work, it is so arranged that they do two hours in the morning and two in the afternoon. This work consists of the various activities necessary to the conduct of the Sanatorium. The tasks assigned them will be shown in detail later in chart form. In this connection, it should be mentioned that with few exceptions the class of patients received at this Sanatorium are those who are dependent upon manual labor for a livelihood.

PATIENT EMPLOYEES

When a patient's condition improves to such an extent that he feels able to take a paid position, he makes application to the Resident Physician who examines him and if, in his opinion, the patient is physically fit, he puts his name on his list of applicants for paid positions. When a vacancy occurs, the Resident Physician submits this list to the Physician in Charge who looks up the history of each applicant on chart 4 and makes his choice accordingly.

The advantages derived by the patients having paid positions are:

First. His economic rehabilitation before his return home, the idea being to pay a nominal salary which enables the patient to supply his various needs while at the Sanatorium. If he works long enough, he should have a surplus remaining which will support him on his return to the city until he is able to secure the kind of employment he is best suited for. He would otherwise be compelled to take the first position offered, owing to his urgent need of funds.

Second. The fact that he has been working during his stay at the sanatorium will make it infinitely easier for him to take up his work on his return to the city, than it would otherwise have been if he had spent all his time in resting and in addition the weight he has gained will be much more apt to remain with him.

The advantage the sanatorium derives from its patient employees is one of economy, as it is enabled to avail itself of labor at very much less cost than if regular city employees were used, thus reducing the running expenses by thousands of dollars a year.

When patients are admitted to the sanatorium they are expected to rest for the first sixteen days, during which time those who do not develop elevation of temperature, rapid pulse or other adverse symptoms make their own beds and during the second week do light shack work. On the eleventh day they begin their daily walks accompanied by a walking captain. These walks are ten minutes in duration, morning and afternoon, on the first day; and increase ten minutes each day until they walk one hour morning and afternoon. On the sixteenth day, at the completion of their afternoon's walk of one hour, they are inspected by the resident physicians who take note of how they react to it in regard to pallor, rapid pulse, dyspnoea, etc.

During their stay in the reception shacks, the resident physicians have an excellent opportunity to observe the patients and become thoroughly familiar not only with their physical condition but also their temperament, which helps them greatly in making their work and shack assignments.

The frequent changes in the staff personnel, which was much depleted during the period of the war, in addition to the handicap of a falling census and the admission of a poorer type of case, made it necessary for me to classify the patients so that their selection for work assignments would be simplified and placed on a scientific basis. As there are over 300 positions in the sanatorium filled by patients, both paid and non-paid, it can be seen how important it is to have the patients classified.

The advantages of this classification are as follows:

First. It gives the physician in charge the opportunity to find out quickly the condition of all the patients and puts him in a position where he can select the patients for paid positions and advise, when called upon, in the selection of patients for regular work assignments.

Second. It also puts him in a position where he can quickly decide if a patient who complains of his work assignment has a legitimate reason for complaint.

Third. It helps the resident physicians immeasurably in making their work assignments and is of great aid to their chief clerks who occasionally have to make a change in assignment at the last moment, in the absence of the resident physician, owing to the sudden illness of a patient, previously assigned.

The first step found necessary in classifying the patients, upon the basis of work assignment, was to revise the present accepted classification of tuberculosis to meet the immediate requirements. To render it more simple, we shall speak of incipient A as 1A, moderately advanced A as 2A, far advanced A as 3A, etc.

All patients were then divided into four classes:

Class A	1A 2A
Class B	3A 1B 2B
Class C	3B
Class D	1C 2C 3C

The class A cases we consider the ideal patients for the great majority of our paid positions and some non-paid positions where the work is fairly hard; such as maids in the patient nurses' home and the maid who cleans the dining hall.

The class B cases we consider to be well enough to fill easy paid positions when we are unable to obtain class A cases; such as clerk in the linen room, postmistress, postmaster and bath attendant, as the hours in these positions are short and the work not hard, and in non-paid positions where the work is much easier than that done by class A cases.

The class C cases were rarely used except when we were unable to obtain class B cases and then only in positions such as librarians, temperature clerks and weather clerk where the work attached to the position was nil and they had plenty of time to sit down and rest.

Class D was put in to complete the classification. The patients coming under this class are bed cases and should be under care in tuberculosis hospitals and not in a Sanatorium, although we had quite a number of that type of cases.

In making out this classification of patients, it was found convenient to make up four (4) charts as follows: No. 1, Work classification; No. 2, Work assignments; No. 3, Weekly census and stage of disease; No. 4, Patient's history and past work assignments.

Chart 1: Work classification. On this chart are shown the four classes, A, B, C, and D, under which are placed all the positions filled by patients in the Sanatorium under the headings class A, class A or B, class B, class B or C. Under class A are placed the great majority of paid positions and a few non-paid positions where the work is considered fairly hard such as dining hall maid and maids in patient nurses' home, etc. Under class A or B are placed those paid positions where the hours of duty are short and the work not hard and non-paid positions such as waitresses, dishwashers, laundry workers, etc. All cases coming under this classification are filled preferably from class A but could be filled by patients coming under class B when we are unable to obtain them from class A. Under class B are placed most of the remaining non-paid positions such as office clerks, pantry maids, linen room assistants, etc. The work done by the patients coming under this heading is light and rarely averages more than three hours per day. Under class B or C are placed the few remaining positions such as librarians, temperature clerks, dietitian's clerk, etc. The work attached to these positions is so light that it can be done by class C cases but we rarely use cases coming under this heading, except when we are unable to obtain class B cases.

Chart 2: Work assignments. On this chart are shown positions filled by the patients in the sanatorium, both paid and non-paid. It enables the physician in charge and the resident physicians to tell at a glance what each patient in his respective class is expected to do each day and the number of hours his work assignment calls for.

Chart 3: Weekly census and stage of disease. This chart consists of a weekly census of each unit with the stage of disease of each patient to the right of his name. These census sheets are carried around by the physician in charge and have proved of great value to him when he wished to know what stage a patient was in whom he met on his daily rounds.

Chart 4: Patients' history and past work assignments. This chart, which is made large enough to cover a period of three months, gives a brief history of each patient under the following headings: Date of admission, Stage of disease, Name, Age, Previous occupation, Present occupation, Weight on admission, Present weight, Sputum, Date of week ending.

Work classification		Stage classification by physical signs and symptom
Class A	1 A	Incipient A
	2 A	Moderately advanced A
	1 B	Incipient B
Class B	2 B	Moderately advanced B
	3 A	Far advanced A
Class C	3 B	Far advanced B
	1 C	Incipient C
Class D	2 C	Moderately advanced C
	3 C	Far advanced C

FEMALE UNIT

CLASS A		
4 Patient nurses	Female Infirmary	Paid
1 Captain	Reception shack	"
1 Maid	Germicide Building	"
1 Forelady	Laundry	"
1 Telephone operator	Operates switchboard	"
1 Maid	Female dining hall	Non-paid
CLASS A or B		
1 Postmistress		Paid
2 Dishwashers	Female Infirmary	Non-paid
19 Waitresses, 2nd setting	" dining hall	" "
8 Mangle workers	Laundry	" "
CLASS B		
3 Clerks	Office of Resident Physician	Non-paid
1 Assistant captain	Reception shack	" "
8 Pantry maids	Female dining hall	" "
3 Women	Sewing room	" "
CLASS B or C		
1 Librarian		Non-paid

MALE UNIT

CLASS A		
1 Orderly - day	Male Infirmary	Paid
1 Laboratory chief	Laboratory	"
1 Head waiter	Male dining hall	"
1 Dishwasher - machine	" " "	"
2 Drivers		"
2 Blanketmen	Collect blankets and bedding	Non-paid
CLASS A or B		
1 Pharmacist	Dispensary	Paid
2 Meal carriers	Male dining hall	Non-paid
1 Houseman	Staff House	" "
2 Gardeners		" "
CLASS B		
3 Messengers		Non-paid
1 Walking captain	Charge of daily walks	" "
3 Silverwashers	Male dining hall	" "
4 Servers, 2nd setting	" " "	" "
CLASS B or C		
4 Clerks	Take patients' temperatures	Non-paid

CHART 1. WORK CLASSIFICATION

POSITION	DUTIES	HOURS OF DUTY
	FEMALE UNIT	
Captain of Reception Shack Class A (1) Paid	Admits and instructs new patients as to the care of sputum, personal cleanliness etc. Gives each patient a copy of the rules and is held responsible for their strict observance. Takes temperatures, gives out medicines and cares for sick patients under supervision of nurse.	12 M to 12 M Assigned 8 hrs. On call when needed.
Mangle workers Class A or B (8) Non-paid	Feed mangle and fold clothes.	1 PM to 4 PM Work 4 days a week.
Sewing room Class B (3) Non-paid	Mend institutional linen. Make towels, pillow cases, nurses' uniforms and do whatever mending is required.	9 AM to 12 M
Librarian Class B or C (1) Non-paid	Is responsible for books in library and keeps record of books loaned to patients. Keeps library clean.	4 PM to 7 PM Assigned 2 1/2 hrs.
	MALE UNIT	
Orderly - day Class A (1) Paid	Serves meals under direction of nurse and waits on bed patients. Gives bed baths twice weekly. Sees that each patient washes his hands and uses mouth wash before each meal. Assorts and takes all soiled linen to linen room daily.	8 AM to 8 PM Assigned 8 hrs.
Meal carriers Class A or B (2) Non-paid	Carry meals to bed patients in sub-standard and outside shacks.	6.45 AM to 8 AM 11.30 AM to 12.30 PM 4.30 PM to 6 PM Assigned 2 3/4 hrs.
Servers - 2nd setting Class B (4) Non-paid	Dispense all food for second setting.	7.15 AM to 8.15 AM 12.15 PM to 1.15 PM 5.15 PM to 6.15 PM
Clerks Class B (4) Non-paid	Enter temperatures, weights, sputum, urine, blood and dental examinations on charts.	10 AM to 12 M 2 PM to 4 PM

On the above chart eight (8) positions taken from Chart No. 1 are shown with their duties and hours of assignment. The original Chart No. 2 shows duties and hours of assignment of the one hundred and fifty six (156) positions shown on Chart No. 1.

CHART 2. WORK ASSIGNMENT

FEMALE UNIT			MALE UNIT		
A. E.	...	1 B	A. V.	...	1 A
B. A.	...	2 A	B. S.	...	2 B
C. N.	...	3 B	C. P.	...	1 A
D. L.	...	3 A	D. G.	...	1 A
E. T.	...	2 A	E. M.	...	2 A
F. C.	...	2 A	F. M.	...	2 B
G. R.	...	2 B	G. V.	...	2 A
H. F.	...	1 A	H. G.	...	2 B
I. D.	...	2 A	I. J.	...	2 B
J. A.	...	2 A			
K. I.	...	1 A	K. J.	...	2 B
LaB.M.	...	1 A	L. F.	...	1 A
M. A.	...	2 B	M. J.	...	2 A
McD.A.	...	2 A	McA.D.	...	2 B
N. C.	...	1 A	N. S.	...	1 B
O'D.C.	...	2 B	O. V.	...	1 B
P. V.	...	1 A	P. S.	...	2 B
R. A.	...	3 A	R. A.	...	1 A
S. G.	...	1 A	S. F.	...	2 B
T. C.	...	2 A	T. N.	...	2 A
U. M.	...	2 A			
V. M.	...	1 A	V. A.	...	2 B
W. E.	...	2 B	W. T.	...	1 A
Y. Y.	...	1 A			
Z. C.	...	1 A			

The above chart shows the initials and stage of disease of forty six (46) patients whose names were selected from the original Chart No. 3 which contains the names of all the patients in the Sanatorium arranged in alphabetical order.

Chart 3. Weekly Census and Stage of Disease

CHART 4

Patients' history and past work assignments

DATE OF ADM.	STAGE	NAME	AGE	PREVIOUS OCCUPATION	PRESENT OCCUPATION	WEIGHT ON ADMISSION	PRESENT WEIGHT	SPUTUM	WEEK ENDING*			
									Jan. 5th	Jan 12th	Jan. 19th	Jan. 26th

* Note: Columns for successive weeks covering period of three (3) months follow in the chart that is kept on file in the office of the Physician in Charge.

The work assignment of new patients and changes in assignment of older patients are made every Saturday afternoon by the resident physicians assisted by their chief clerks. At this time the ward chart of each patient is carefully gone over and temperature, pulse rate and weight for the previous week noted, after which the resident physician refers to charts 1 and 2 and makes his assignments according to the stage of disease of the patients and their adaptability for the positions to be filled. These lists of new assignments are posted in each dining hall and a copy given to the physician in charge, resident physicians and their chief clerks. As these lists show the assignments at the beginning of each week and chart 4 under the heading, "week ending," shows the assignments for the previous week with the changes, if any were made, it can thus be seen that the physician in charge has in his possession a complete record of the work assignments of all assigned patients in the sanatorium.

Chart 4 was made up for the use of the physician in charge and has proved invaluable as an aid to him in the assignment of patients to paid positions. For instance, if a certain paid position is to be filled, it is but a few moments' work for him to look through the chart and pick out those patients who had a position similar to the one to be filled prior to their admission, the stage of disease, and whether or not they have gained in weight. He can also see what their work assignments for the past few weeks have been and if they have lost any time through illness. When the physician in charge has selected from this chart the patient whom he considers the proper one for the position in question, it is a simple matter to ask the resident physician to look over the patient's ward chart and report to him what his medical history has been since admission. It can thus be seen how much easier this is than it would be to have the resident physician look through each ward chart consecutively as he formerly did when he wished to find a patient to fill a vacant position.

IDEALS IN THE TREATMENT OF TUBERCULOSIS

THE IDEAL SANATORIUM, THE IDEAL PHYSICIAN, THE IDEAL NURSE, AND THE IDEAL PATIENT[1]

S. ADOLPHUS KNOPF

New York

Among the ideals, hopes and dreams, to the realization of which I look forward, now that our victorious war has come to a close, is the eradication of tuberculous disease. I am grateful for this opportunity to give expression to these thoughts for which I could hardly have a better occasion than the anniversary of the founding of a sanatorium which is among the institutions that have always striven towards the goal of the ideal. May I therefore hope that you are willing to listen for a few moments to my conception of what is to be understood by an ideal sanatorium as an institution for the tuberculous, an ideal physician for tuberculous patients, an ideal tuberculosis nurse, and an ideal patient who is or has been afflicted with tuberculosis and who may or who may not have passed through a sanatorium.

The ideal sanatorium is one which, in proportion to its capacity accomplishes the greatest amount of good for the greatest number of people. The good which it accomplishes is manifested by the manner in which the institution deals with its patients and the interest it takes in their physical, mental, and even spiritual welfare during their sojourn within its precincts; and also by the continued interest it takes in the economic as well as the physical well-being of the patients discharged from the institution. The typical sanatorium strives to live up to its name. It is called sanatorium from the Latin word *sanare*, to heal, and is a healing institution. It is not a sanitarium, from the word *sanitas*, health, which rather means a health resort where people often go for more or less nervous and often only imaginary ailments. The primary function of the ideal sanatorium for the tuberculous is to heal the patient, to heal

[1] An address delivered at the Fifteenth Anniversary of the founding of the Gaylord Farm Sanatorium, Wallingford, Connecticut, September 13, 1919, to an audience of physicians, laymen, and several hundred ex-patients of the Sanatorium.

completely all those for whom it is possible. For those who have not arrived at the sanatorium early enough to become completely healed, it strives to arrest the disease and improve the condition of the patient and to accomplish an economic cure; that is to say, build up the patient's physical and mental condition and give him the necessary training by teaching him what he can and what he cannot do, so that he may safely be trusted to go out into the world again and earn his living.

Since the majority of tuberculous patients are recruited from the laboring classes, it has always seemed to me best, and experience has borne it out, that we should treat and cure these patients in the same or nearly the same climate in which they will have to live and labor after their restoration to health. While the cure of the consumptive individual in his home climate may often require a longer time, in the end there is an advantage to be gained from this. As a rule, relapses are fewer and the cures more assured and lasting than those obtained in milder climates. We need not therefore look far away for the location of our ideal sanatorium. The best climate for the average pulmonary patient, in the earlier and more hopeful stages of the disease, is the one where extremes of temperature are not too great, and where the air is pure with relatively little humidity, much sunshine, and all the conditions which permit the patient to live comfortably out of doors the greatest number of days of the year and the most hours out of the twenty-four.

The ideal sanatorium should of course be well built and well equipped. Experience in the United States has demonstrated that the cottage and small pavilion plan, originated by Trudeau, with special infirmary and administration building, is far superior for all kinds of cases, early and advanced, to the one-house system in vogue in European sanatoria. Where the ground is expensive, as it usually is near large centers of population, the ideal sanatorium, particularly for a public, charitable or semi-charitable institution, should be composed of pavilions or King lean-tos, accommodating from 10 to 20 patients each; and, if possible, connected with one another and the administration building by covered galleries which in rainy weather may serve as a promenade for the patients. The most serviceable ward, pavilion, or cottage is one which is constructed so that the patients' bedrooms connect with the porch and the beds can be moved outdoors whenever the weather and the patients' condition permit, thus giving the greatest amount of fresh air by day and by night. No matter what the arrangements for outdoor life may be, baths and dressing rooms should be warm; and a southern expos-

ure for bedrooms and porches is of course the best in our temperate zone, as well as in colder regions.

The ideal sanatorium is also supplied with all the modern appliances for diagnosis and treatment of the disease, such as completely equipped laboratories for the examination of sputum and urine and for serodiagnosis, and an X-ray outfit permitting thorough fluoroscopic and stereoscopic examinations and the taking of good X-ray photographs. There should be one or several darkrooms equipped for laryngological and ophthalmological examinations, an inhalatorium, hydrotherapeutic appliances, massage rooms, one or several artificial pneumothorax apparatuses, and an operating room where urgent surgical operations can be performed. Last, but not least, a dental chair with a competent dentist will be necessary to render ideal service to an institution which will meet all the requirements of modern phthisiotherapy.

The modern conception of the tuberculosis problem, however, also requires the ideal sanatorium to provide work for the prevention of relapses after an arrest of the disease has been obtained. To this end, a department for what we may call the after-cure, should be established in connection with the sanatorium. Here the patient should be specially prepared for resuming his former occupation and trained to withstand the less favorable environment or conditions to which he will be inevitably exposed when again going out to earn his living. To overcome the flabby muscular condition which results from a prolonged rest cure, the patient should be given a course of massage. His respiratory function may also have become indolent through the necessarily enforced quiet breathing during the active stage of the disease; so his breathing capacity should also gradually be developed anew by means of carefully graded breathing exercises. The hematosis and circulation in general will be vastly improved thereby. If the patient has not become thoroughly accustomed to the daily use of cold water on his body, the after-cure division would be a splendid place to train him; for this is the best means to strengthen the cutaneous and nervous systems, and thus cause the patient to become less susceptible to the invasion of microörganisms of ordinary colds and grippes. To this end, a judicious application of cold water should be instituted in the form of an ablution or spray, beginning with 85° F., going down gradually 5° every few days to 40°. The temperature that usually comes out of the cold water faucet is 40° to 45° F. Of course, one should always be watchful for a quick and complete reaction after the application of the cold water and when this

reaction is retarded a return to the warm bed long enough to overcome any chilly sensation is advisable. To become chilled by using the cold water at too low a temperature or too long at a time should be avoided. This is as important as to avoid the direct causes of colds, such as the taking in of the microörganisms known as the bacillus catarrhalis and the bacillus of grippe. In times of grippe epidemics one should avoid the careless sneezer and careless spitter as individuals principally responsible for spreading colds, and the recovered tuberculous patient should be doubly careful.

To the massotherapeutic, respiratory and hydrotherapeutic measures just described may of course be added heliotherapy in the form of sunbaths, by exposing the chest or the entire body to the rays of the sun, under the direction of the physician.

Beside the reconstructive value of these physiotherapeutic means, there is another incontestable advantage to be gained from massotherapy and respiratory therapy. After having been massaged for a short time, the patient should himself help toward the redevelopment of his muscles by certain calisthenic exercises. These, as well as the respiratory exercises, done under careful medical supervision, will show whether or not the patient's disease has really been arrested. We might just as well confess that relapses occur even in cases where the physical examination revealed no activity and the symptoms had disappeared. I have made mistakes in this respect and I believe others have had the same misfortune. But now, instead of telling the patient to go to work as soon as all the active symptoms have quieted down and only the physical signs of an arrested case remain, I start gradual breathing exercises and calisthenics and the patient is examined frequently, so as to determine whether or not an activity is reawakened. If after four to six weeks of preparation by massage, hydrotherapy and respiratory therapy, repeated examinations do not reveal any renewed activity, we may be reasonably certain that the disease is sufficiently arrested to allow the patient to resume physical labor without fear of relapse.

As long as the patient is on the reclining chair he breathes but little and very quietly. Any physical exertion will accelerate the respiratory movements and it would seem unwise to allow the respiratory system to be submitted brusquely to so great a change as is inevitable when the patient begins to do physical labor which cannot be regulated as accurately as breathing exercises, especially away from the sanatorium. Thus even for graded labor, which is of great advantage, the careful prepara-

tion by breathing exercises is a safe and valuable procedure, because the patient can begin very slowly while yet on the reclining chair.

In regard to graded labor, or what is now more commonly called occupational or vocational therapy, the military hospitals for the tuberculous, which were created during the last years of the World War, have given us a splendid demonstration of the value of giving the tuberculous patient something useful to do during his convalescence, and even during his acute illness, provided he is not highly febrile. He will usually feel happier and more content, eat better, and make a more rapid progress toward recovery if he is occupied with something useful in which he can take an interest. During a lecture tour for "The Prevention of Relapses in Cases of Arrested Tuberculosis among Soldiers and Sailors," which I undertook in the Spring of 1919, it was my privilege to visit the Recuperation Hospital for tuberculous soldiers in Denver, Colorado. There all possible occupations and trades were taught to the patients according to their physical condition and individual tastes and aptitudes. Crocheting, knitting, typewriting and drawing were given to bedridden patients, and wireless telegraphy, carpentry, truck-farming, automobile repairing and construction, etc., were taught to the convalescent. It would seem to me that the ideal sanatoria of the future, especially those established by state or municipality for all classes of people, might in this respect very profitably imitate our military and naval hospitals for the tuberculous.

There is one more thing we have learned from our military hospitals which we should utilize in our ideal sanatoria, particularly in those intended for the general public, that is to say, the poor and those of moderate means. In these institutions we not infrequently find foreign born citizens, and alas, altogether too frequently Americau born citizens, who are illiterate. While taking the cure all these so badly in need of education should be taught to speak, write and read the English language and given the rudiments of a knowledge of civic duties and responsibilities without which we cannot have loyal American citizens.

Even after their recovery patients are not always able to resume their former occupations. They may not be physically strong enough to do so; or there may be sanitary or other reasons which make a change of occupation advisable. Occupational or vocational therapy, judiciously applied for the tuberculous, will not only help us to obtain a greater number of arrests and cures, but will indirectly repay the community and state by adding to the wealth of the nation through increased produc-

tivity. Occupational therapy has not as yet been practised systematically and to the fullest extent at Gaylord Farm, but what has been done has resulted in gratifying success.

It is not polite to become personal, but since my own share in the achievements of the Gaylord Farm Sanatorium have been nil, and I have only been attached to its staff by courtesy as an honorary director, I feel that I have a right to speak of the achievements of this institution. Up to the tenth anniversary of the Gaylord Farm Sanatorium, at which it was my privilege to be present, this institution had expended $800,000. Now, what have the patients given back to the state in return for these expenditures which again made them breadwinners and supporters of their families? Dr. Lyman, who has kept a careful record of the earning capacity of those who have left the sanatorium as cured or partially cured, finds that they have added something like $2,000,000 to the wealth of the country since they left this institution. That surely pays even if the elimination of a certain number of state liabilities and the decrease of the total sum of unhappiness are not taken into account. Ninety per cent of the graduates who went to Gaylord Farm in the early stages of tuberculosis are in good health after ten years of work. That percentage cannot be exceeded outside of sanatorium ranks. If the first thousand men passing a given corner were caught and ear-marked to-day it is not likely that 900 of them would be alive and vigorous ten years later. In the moderately advanced cases 60 per cent of the men were restored to health at the sanatorium, and 10 per cent even of the. dying were turned out well men. That is a statement of literal fact. An "advanced" case of tuberculosis is a "dying case," if the disease is left to itself, yet one patient in ten has been restored to fairly good health and earning capacity.

There must be, and fortunately there are, sanatoria which take care of advanced cases, try to improve the condition of the patients, make them comfortable and prolong their lives by judicious care and treatment. They become a haven of rest for the more advanced and less hopeful cases among the tuberculous.

Next to its mission of healing, the ideal sanatorium for the tuberculous has a mission to teach. It is a school, a college, where the patients can and must learn many things. Any institution for instruction is composed of teachers and pupils, and in the ideal sanatorium for the tuberculous the physician is the teacher, the nurse the assistant teacher, and the patients are the pupils. The function of the physician, presid-

ing over and directing the medical care, is thus a double one. Of course he must be primarily a practitioner of medicine and well trained for his specialty. This training he must have received first, through a general medical education in a good medical school, followed by an internship in a good hospital and a few years as a general practitioner, where he has had opportunity to see all kinds of diseases and to acquire the tact, patience, perseverance and sound judgment so essential to the success of a family physician. Undoubtedly, as a general practitioner he will have come across a good many cases of tuberculosis, and when his interest in this disease is aroused to a degree that he feels that he would wish to devote his knowledge, experience, nay, even his life, to the relief of those suffering from it; if, so to speak, he feels the call within him to minister to the needs of the tuberculous, even as a young man feels the call of God to enter the ministry; then he is started on the fair road to become some day the ideal physician for the tuberculous. Nevertheless, all the knowledge a tuberculosis specialist should possess can only rarely be attained in general practice. The best tuberculosis specialists are those who have had training as assistants in good sanatoria, and if to this they can add a special course, such as is offered by the Trudeau School at Saranac Lake, their medical equipment for tuberculosis work will be about as good as it can be made.

Medical knowledge, that is to say, being well versed in phthisiotherapy and the diagnosis of tuberculosis, however, will not alone suffice for the ideal sanatorium physician or tuberculosis specialist. There is no disease which has so large a social and psychological aspect as tuberculosis; and the physician who wishes to be a specialist in this line and who neglects to study the social aspects of the disease and the soul life of the tuberculous patient will never become the ideal physician. Those of us who have endeavored to study the social aspects of tuberculosis as a disease of the masses have long since learned that it is as important as the medical aspect.

Thoughtless procreation; women working often up to the time of confinement and forced to the resumption of work shortly after confinement; child labor; unsanitary schools; an overcrowded curriculum in schools and colleges to the detriment of the physical wellbeing of our children and young men and women; marriages among the physically unfit and mentally disabled; unsanitary housing; unsanitary factories and workshops; underfeeding; intemperance and the ignorance of ordinary sanitary laws and a disinclination to obey them; lack of facilities to take

institutional care of early, moderately advanced, and far advanced cases of tuberculosis; lack of preventoria and open air schools for predisposed children; lack of sanitary workshops for the recovered tuberculous invalids; all these involve vast sociological problems which must be studied by the tuberculosis specialist in order that he may help to combat the predisposing causes. To do this must be as sacred a duty to the real physician as his endeavor to cure and restore to health and happiness each tuberculous individual.

Next to being a sociologist the ideal physician for the tuberculous must be a psychologist, but not one who merely studies abnormal phenomena or even the wondrous working of a normal intellect. He must be also the sympathetic physician of the suffering soul, the worried mind, the saddened heart. I feel deeply sorry for the physician whose experience in tuberculosis has not convinced him that the tuberculous patient is just like any other patient with no particular mental and psychic characteristics, and it grieves me deeply when I read statements to the contrary.

In his latest textbook Fishberg writes (page 206): "A psychic trait of the consumptive which has been noted by most writers is selfishness. He becomes egotistical and egocentric. He is interested in the welfare of but one person—himself—to the exclusion of all who have depended on him before. He will eat costly food while his children starve; he will make unreasonable demands on his relatives and friends and show no gratitude." Fishberg then quotes Saxe as an authority, endorsing the following astounding statement, "The ascendance of selfishness plays the most important rôle in the molding of the mental traits of the tuberculous." Dr. Fishberg seems to be entirely oblivious to the fact that our greatest authorities on tuberculosis, such as Laennec and Grancher of France, Brehmer and Dettweiler of Germany, Trudeau and King of this country, were all tuberculous and distinguished themselves by their unselfishness and devotion to suffering humanity. The vast majority of tuberculosis specialists in this country who volunteered and served in the American army in the great world war have been or are still tuberculous. Who would dare to ascribe to these noble men anything but self sacrifice and devotion to the highest ideals of humanity and patriotism? Not a few of the heroic tuberculous invalids in our own and allied countries even went to their death in battle. Let me recall only one name, that of the noble Frenchman, Captain Georges Guynemier, who fought 800 battles in the air and brought down 74 enemy air planes, of which

54 are officially recorded, and thus became the famous ace of aces before his death in action over the German line.

I wish Dr. Fishberg could be here to-day to see this throng of patients and ex-patients and to look into their bright and happy faces where it would be difficult for him to discover a sign of selfishness, because good fellowship and perfect gratitude toward the sanatorium and their physicians are plainly visible in every face.

My very first experience as a young intern in one of the European sanatoria taught me two things.

The first was that the tuberculous patient has no special mental characteristic and can be as bad and as good as any other type of patient or any healthy man or woman, and that the disease in itself never, except perhaps in the very last stages and even then very rarely, clouds his judgment or causes him to be less thoughtful of others.

I well remember the second lesson which this early experience taught me. It was the necessity for the true physician not merely to look after the physical but also the mental welfare of the patients. In the division which was assigned to me I had a man of unusual refinement and culture, a dutiful patient who obeyed me implicitly in spite of my youth and inexperience. He was doing splendidly; he had gained in weight; his lesion had become less active; in short, he was on the road to recovery. At the next examination, however, I found he had lost in weight and was not nearly in as good condition as four weeks previously. I prescribed a tonic to improve his appetite and advised more rest; and still he did not improve. I reported the condition to my chief, the great Dettweiler, and all he said to me was: "My son, see if there is anything on his mind." To be brief, I discovered that the man had worried because the pension which his former employer had granted to his family while he was absent had been cut down and only the amount necessary to keep him in the sanatorium was given him. He knew that his loved ones suffered and were depriving themselves of the very necessities of life so that he might stay in the sanatorium and complete his cure.

On a recent visit to Loomis, Dr. Bertram H. Waters, the physician in chief of the sanatorium, told me that experience at the institution showed just the reverse of what Dr. Fishberg described as being the average state of mind of the tuberculous. Dr. Waters assured me that he and his assistants constantly had to contend with the anxiety and worry which the patients under their care manifested concerning their families left at home.

Had I the time I could record hundreds of similar instances which showed me beyond doubt that the tuberculous invalid is not egotistical, not egocentric, will not eat costly food while his children starve, and that he is not ungrateful. How many well-to-do dying consumptives have provided large sums in their last will for the care and treatment of the consumptive poor, and how many patients, rich and poor alike, prior to their passing away have pressed the physicians' and nurses' hands and thanked them for what they had done to alleviate their sufferings!

To return for a moment to the patient into whose soul life I had failed to enter until my venerable teacher called my attention to my neglect. A letter addressed by the sanatorium authorities to the employer of my patient resulted in the continuance of the complete pension which assured provision for the family of the patient as well as payment of his sanatorium bills. The patient's appetite again improved, he again gained in weight; and after a few months we were able to discharge him as an arrested case happy to be able again to assume the responsibility of providing for his family.

This, as well as many similar cases in which entering into correspondence with the family was helpful in restoring the patient to health and happiness, have taught me that it is well for the sanatorium and private physician, who has the welfare of his tuberculous patients at heart, to try always to know something about the family of the patient, and if possible be in communication with it. Much can thereby be learned of how best to manage the case; and indirectly one can also, as far as possible, instruct the family of the patient. Education of the family is particularly timely and important prior to the return of the patient to his home.

Your Superintendent, Dr. Lyman, has presented the situation very clearly by the following statement:

> We often speak of our institutions as training schools, claiming that the educational feature of their work is the most valuable of their functions. This is true, but it is also true that in order to secure permanent results it is fully as necessary to educate the family as the patient, and so far we have made but little effort to do this.

Lieut. Col. Jabez H. Elliott, of Toronto, in a very interesting article on "Diseases of the Respiratory System as Medical Problems in Rehabilitation" (*The Canadian Medical Quarterly*, September, 1919), makes the following suggestions regarding the necessity of post-sana-

torium care of the patient, including incidental visits and inspection of his family,—suggestions which I gladly endorse as an ideal for us physicians:

To make our results as permanent as possible we must follow the patient to his home and establish a supervision which will aid in: (1) The prevention of relapse. (2) The detection of symptoms of relapse before serious damage is done. (3) The establishment of sanitary measures in the home and to lessen the possibility of contact infection. This would include education of the family. (4) The supervision of the members of the family, and especially the children, who are to be treated as contacts. For this we require the services of a nurse trained in social work, and the services of skilled physicians. In the larger centres special chest clinics are available, others could readily be established where needed, and in rural communities the services of the local physician or a traveling special physician could be arranged for.

In some states, such as New York, Massachusetts, and Vermont, such travelling clinics under expert direction are already in operation. Personal experience with them in New York has shown me the invaluable service they can render in the discovery of early cases, the prevention of relapses among old sanatorium patients, and in the education of the families in tuberculosis prophylaxis.

Colonel Elliott continues:

The visiting nurse should begin her work while the patient is still at the sanatorium, where she meets him and secures his interest and coöperation. With a visit to the family before his return she can begin their education in coöperative measures, so that when he reaches his family they will have the facilities for his after-care and will be ready to help him by having a proper attitude toward him and his practice of those measures essential to his further progress. The nurse should not only have knowledge of sanatorium routine and prophylaxis, but must have a training in social service work as related to public health, and, above all must have tact, patience and resourcefulness to deal with difficult situations.

To these qualifications of an ideal tuberculosis nurse, may I add that she must be physically well and strong and mentally alert, and able to inspire her patients by her healthy and cheerful appearance. If she herself has had tuberculosis and is an arrested or cured case, she should not hide this fact; for it will rather add to her powers of assuring the patients of the curability of the disease. She must have the same fine qualities of mind and heart which are expected of all physicians, but

particularly of the tuberculosis specialists—cheerfulness, helpfulness, and sympathy, but firmness when this is required. The tuberculous patient is often one who has contracted the disease in the battle of life or struggle for existence. The late Professor Landouzy of Paris, when speaking of the soldiers who had contracted tuberculosis, called them "*blessés par la tuberculose*" (wounded by tuberculosis). To the wounded by tuberculosis as well as to the wounded in battle in the World War, our American nurses and those of our allied nations proved to be veritable ministering angels. The ideal tuberculosis nurse should be the same in peace time as she was on the battle field and in our military hospitals. She must be phthisiophilic, not phthisiophobic. No matter how skilful and well trained a nurse may be, if she is afflicted with the slightest degree of phthisiophobia, she should never become a tuberculosis nurse. Just as the best tuberculosis specialist is he who, after general practice, feels the call to devote his life to this difficult specialty, so will the nurse who, after general training and experience, believes that she can accomplish the greatest amount of good by choosing tuberculosis as a specialty, become the ideal tuberculosis nurse.

After having given our conception of the ideal sanatorium, the ideal physician, and the ideal tuberculosis nurse, we may now say a final word regarding how the tuberculous patient may become the ideal patient.

To the patient knowing and realizing that he is tuberculous, I would say first, be true to yourself and to your physician. When he takes your history, tell him everything. Don't hide anything from him: even tell him your family and your personal affairs, and your love affairs and business troubles,—if you have any; as these may have a bearing on your physical and mental welfare. Tell him your symptoms, your physical sufferings if you have any, and also those of your mind if that is disturbed. Tell him your financial condition, your mode of life, and what you think are your own shortcomings. After his examination, about the first advice the physician will probably give will be the exhortation to work and to rest with the object to get well. By working to get well is understood keeping your rest hours, keeping your sleeping hours and your eating hours with religious punctuality, exercising only as you are allowed to exercise; taking medicine only when and as it is prescribed for you, and never taking medicine when not prescribed. Report any intervening symptoms or irregularity to your physician. If something worries you call on him. The ideal physician will be to

you as much a physician of the soul as of the body. Trust him, have confidence in him. Don't talk about your troubles or symptoms to your fellow patients, nor listen to the recital of their symptoms or their past history. Be sympathetic to their sufferings and their troubles, but content yourself with cheering them up and telling them to trust in their physician and in God and not to worry. By complying strictly with the rules and regulations of the institution or those given to you by your private physician, you give the best example to other patients. Be charitable to the shortcomings of the less educated, less refined, and less cultured. Treat them as you would wish them to treat you were the conditions reversed.

When you have recovered and have returned to your former home or gone to another community, keep in touch with the sanatorium authorities or with the physician who took care of you while you were away from home, in a health resort or elsewhere, and have yourself reëxamined from time to time. Remember all that you have learned from the sanatorium authorities or your physician and consider yourself an apostle of the prevention of tuberculosis and the prevention of disease in general. Teach those who do not know the value of fresh air, deep breathing, clean teeth, and sanitary living in general. Teach the blessing of spending as much time as possible out of doors, and the value of cold water inside and outside, and of a sober and well regulated life as the best means to prevent disease. Spread the gospel of the preventability and curability of tuberculosis and the necessity of an early diagnosis so that a cure may be expected with reasonable certainty. In communities where no antituberculosis committees or antituberculosis societies exist try to establish such associations. Where open air schools and tuberculosis clinics, hospitals and sanatoria are wanting, stir up the authorties and show them where their duty lies. Convince them that it is a financial and moral gain to the community to take care of its consumptive poor at the right time and in the right place, and not at the wrong time and in the wrong place. When you yourself come into the presence of a suspected or already diagnosed case without medical care, tell the patient what you know of the prevention of tuberculosis; and take him to a physician, a dispensary, or hospital so as to give him the best possible chance for recovery. If a kind Fate has made you prosperous, remember that tuberculosis is a costly disease, that state and municipalities alone cannot cope with the tuberculosis problem and that money is needed in most communities to help the consumptive poor. For this

reason I beg you to render personal service where you can and add to this your financial help to the best of your ability. Show your gratitude for improvement and for being cured by helping others to be cured.

Few, if any of you patients, and I am sure none of us physicians, may ever become as rich and as prosperous as the late Andrew Carnegie, yet, because he was an ideal philanthropist, a true lover of his kind, he may well serve as an example to follow. Mr. Carnegie found his greatest happiness in sharing his fortune with others. His benefactions run into millions of dollars, all intended for the betterment of the physical and intellectual welfare of his fellowmen. He did not believe in creeds, but in deeds, and well may we all subscribe to one of his favorite sayings and adopt it as our life's motto and guide,

"Service to Man is the Highest Service to God."

EDITORIAL

INFLUENZA AND PULMONARY TUBERCULOSIS: A CRITICISM OF DOCTOR FISHBERG'S VIEWS[1]

A recent "Current Comment" of the *Journal of the American Medical Association* referred to a paper by Dr. Fishberg of New York in the AMERICAN REVIEW OF TUBERCULOSIS, in which he came to the conclusion that the recent epidemic of influenza in the fall of 1918 and the winter of 1919 had not in any way affected the tuberculosis morbidity rate of the country, or at least of New York City.

Doctor Fishberg's conclusions are so widely at variance with my experience in Asheville, and I might say with that of some of my friends who treat tuberculosis here and in other parts of the country, that I cannot let the statement pass unchallenged. Later I hope to have time to go over my case records and give accurate figures to back up this view. Meantime I would say that in my practice, while, probably owing to the good isolation possible in cottage sanatoria, influenza did not develop in the institutions under my control, not a few arrested cases living in their own homes had severe attacks of influenza, followed by active and alarming bronchopneumonias. The results in nearly every case were more or less dangerous recrudescences of the arrested tuberculosis, from which some of these patients have not yet fully recovered, while a few were aroused to fatal activity.

But whatever the effect of influenza on arrested cases of tuberculosis, I would wish to stress the fact that the carefully taken histories of the large majority of patients who have come to me since the spring of 1919, demonstrate very clearly that this epidemic had a disastrous effect in initiating active trouble in people who had been hitherto perfectly well, or in reawakening processes in those who had given a history of an arrest in the past. While I cannot here give accurate figures as to tuberculosis subsequent to attacks of influenza, I have no hesitation in stating that the majority of the cases treated by my associate, Dr. Ringer, and myself have given unequivocal histories of such an attack in the fall of 1918 or the winter of 1919.

[1] See AMERICAN REVIEW OF TUBERCULOSIS. November, 1919, iii, 532.

Of course I do not refer to those patients who speak carelessly in their histories of "an attack of grippe," a statement of no value, and one which would mislead no careful taker of histories, but of those who in the epidemic time had a s ckness of the well-known character and clearly justifying a diagnosis of nfluenza, and which were so diagnosed by their physicians, as well as by myslf and Dr. Ringer in our history-taking. In these patients the attack of tuberculosis either dated from such an undoubted attack of influenza or developed later after the post-influenzal asthenia, with which we are all so familiar.

As a result then of my own and my associate's experience and of that of friends of mine in different parts of the country with whom I have talked, I am certain that influenza has caused a great increase in the incidence of tuberculosis, and acted as a powerful activator of latent tuberculosis in many people. Judging from my experience I believe that the statistics of the next few years will show that this epidemic will result in a very marked increase in the morbidity and the mortality curves for tuberculosis throughout the country, and were it possible to get statistics on the subject, that quite a large percentage of those who suffered from undoubted influenza in the fall of 1918 and early winter of 1919, developed, as a result and not as a mere coincidence, an attack of pulmonary tuberculosis.

I have ventured to write the above, since I believe that a statement from a prominent authority such as Dr. Fishberg, that influenza has had little effect in increasing the incidence of tuberculosis, may have an unfortunate effect on the profession of the country and may cause them to neglect the danger of the development of tuberculosis after attacks of "flu," whereas I feel that for six months after such an attack every patient should be carefully watched for the possible development of suspicious symptoms.

Charles L. Minor.

STUDIES ON TUBERCULOUS INFECTION

VI. TUBERCULOSIS IN THE GUINEA PIG AFTER SUBCUTANEOUS INFECTION, WITH PARTICULAR REFERENCE TO THE TRACHEO-BRONCHIAL LYMPH NODES

ALLEN K. KRAUSE

From the Kenneth Dows Fund for the Study of Tuberculosis, of the Medical Clinic of the Johns Hopkins Hospital and University

The guinea pig and rabbit are the most commonly used animals in the experimental study of tuberculosis. If bacillary properties, such as virulence, are under investigation we resort to either or both of these animals. If infection is in question, we attempt to carry over to human nosology observations that are more easily gleaned from these animals, both of which are amenable to experimental conditions that can to a large extent be controlled. They have yielded us a scientific foundation for more than one point of view concerning the possibilities of the spread of infection. They have supplied whatever details buttress any sound conceptions of resistance and immunity, scanty though these may yet be. They have been the media of test for almost numberless therapeutic agencies. Because of their availability and cheapness, because of their unusually definite and regular responses to tubercle bacilli and because of the opportunities they present to the investigator to study many phases of tuberculosis on a scale that is large enough to promise sufficient data for correct interpretation, it is likely that for our purposes they will remain the animals of choice.

Now these data of virulence, of infection, of resistance, are expressions of animal reactions to the activities of the microörganisms; and these reactions are, in part at least, dependent on factors that are part and parcel of the animal under observation. In the last analysis, most experimentation on animals is valuable—and justifiable—only in so far as it is undertaken with the purpose of elucidating phenomena that concern human beings. From such investigations we seek to learn facts which we may rationally fit into the human economy. Our "facts" of this nature are really our interpretations of what we observe; and the soundness and completeness of our interpretations will rest almost en-

tirely on the exactitude and amplitude of our knowledge of the processes that have progressed to the point at which we first observe them. It follows, therefore, that, if we are to explain manifestations of human tuberculosis by facts that have been learned more simply and more elementally from the guinea pig and rabbit, we will approach an accuracy and a fulness of explanation only as we can command more and more information that has been attained from these latter animals.

If the story of tuberculous infection of the guinea pig and rabbit were a finished book I should not be at such pains to give point to a platitude. But it has been my experience that the recorded data are anything but complete recitals of all that goes on; and that not infrequently they are misleading. During the last five years and more I have more than once been obliged to readjust opinions concerning human infection that had been based on older and standard views of guinea pig and rabbit infection; for only too often I could not fail to observe phenomena in these animals that did not square with currently accepted generalizations. Again, several years' experimental work on resistance came to a standstill because I became conscious of the impossibility of satisfactorily interpreting my observations, with my detailed knowledge of the progression of infection as inexact and as scanty as it then was. At the same time, several casual observations of architectural differences in the same organs of different animal species coupled with habitual differences of localization of tubercle in these organs suggested possibilities of such factors as anatomic determinants of infection and the need for more detailed studies of infection than had been usual.

Moreover, several years ago it was my good fortune to become acquainted at first hand with the remarkable anatomical studies of the lung which Professor William Snow Miller had been carrying on for the past thirty years. It at once appeared that data which he had obtained from purely anatomic investigations promised, if applied to experimental tuberculosis, to throw more light on several obscure phases of pulmonary infection; and this impression has since been strengthened. At that time Doctor Miller had already begun to approach tuberculosis from the anatomic side, both independently and in association with Dr. Kennon Dunham of Cincinnati. He has since continued and enlarged his interest in the subject with results that have in part appeared in this series of studies ((1), (2), (3)). My indebtedness to him is great and I cannot too highly express my admiration of the beauty and value of the work which has resulted from the precise, ingenious and painstaking methods

which in his hands have approached perfection. Not a few of the observations which are to be recorded in this study and those following it would have been impossible of rational interpretation had Miller's work not been at hand to point the way out.

I am also indebted to several persons who at various times have assisted in the experimental work:—to Dr. Linda B. Lange, who made inoculations and recorded anatomic changes in two preliminary experiments on guinea pigs (4); to Dr. H. S. Willis, who attended to many details; to Dr. Alva B. Craddock, whose gross and histological prepartions of rabbits' lungs were particularly helpful; to Dr. Carl F. Jordan for his injections of the lymphatic system of the guinea pig; to Miss Charlotte Vincent, for her unceasing fidelity and intelligent coöperation in the preparation of specimens; and to Miss Dorothy Peters, for her painstaking and enthusiastic interest in the making of the illustrations that accompany these studies.

To attempt to gain a deeper insight of infection in guinea pigs and rabbits, to the end that this might lend assistance toward clarifying our views of human infection:—this, therefore, has been the main purpose of the studies which will appear in the present communication and several which are to follow. The results of these studies, as they appear, are records of possibilities, as regards human infection; and whenever human infection is under discussion and is not completely understood their possibility should be thought of. If, however, the underlying conditions of particular phenomena in the human being can be shown to coincide with or resemble those responsible for the same phenomena occurring in the rabbit and the guinea pig, then our interpretation, if sound for the latter animals, may with some justification be applied to what may be observed in man.

The present paper will deal with tuberculous infection only as it manifests itself in the guinea pig: any references to infection in the rabbit and other animals will be merely by way of comparison and contrast. It will not attempt to be a complete recital of all that occurs in guinea pig infection: only several of the more noticeable and better known features will be analyzed. That deductions may be plainer, as much anatomic information as is necessary to the purposes of exposition will be introduced. For the same reason the more general features of guinea pig infection, as gathered from several authors and personal experience (5), will be summarized anew.

SOME PERTINENT FEATURES OF GUINEA PIG ANATOMY

The lymphatic system. A very complete and satisfactory study of the lymphatic system of the guinea pig has recently (1917) appeared from the pen of George K. Hashiba (6). Whatever observations I have made on several lymphatic regions confirm those of Hashiba in every respect. The following description is for the most part a composite one, drawn from Hashiba's account and my own records. Lymphatic tissue that is incorporated in various organs and lies within their tissues is designated as intravisceral lymphatic tissue; that which exists free, without integral connection with organs, is termed extravisceral.

In view of the animal's small size, the extravisceral lymphatic tissue of the guinea pig is unusually prominent and abundant. Inframandibular, axillary and groin nodes are easily palpable in every normal animal; and even a crude and hurried dissection will at once reveal many other nodes in the large body cavities, which are quite apparent even without the aid of injection masses. Since most of our studies of infection have followed the changes that result from subcutaneous infection of the groin, it is the mechanism of lymphatic drainage of this region which will receive the most detailed attention.

1. Superficial inguinal (*abdominal-inguinal, Hashiba*) *nodes.* Situated in the subcutaneous tissue of the groin and buried in its fat are the superficial inguinal nodes. According to Hashiba, there are from two to four which are visible, but we have frequently seen more,—five or six,—in normal animals. Our experience also leads us to believe that the actual number may even exceed this; for, sometimes, when after tuberculous infection of the groin there occurred a hyperplasia of the lymph nodes of such a nature that these remained discrete, we have noted as many as seven or eight nodes in the chain. It is likely that under the stimulation of infection lymphatic nodes, which usually escape detection, proliferate and come to light. Efferents run centralwards from node to node of this chain; and, leaving the latter, form two main efferent channels. One is made up of a vessel which runs to the next chain of nodes, the deep inguinals; the other normally consists of two lymphatics which, without being interrupted by the deep inguinal nodes, pass through the inguinal canal into the abdomen and run forwards (cephalicwards) to the common iliac node (see figue 1).

2. Deep inguinal (*inguinal, Hashiba*) *nodes.* These are two small nodes on each side, situated more deeply and close to the abdominal

ring. They receive lymphatics from the popliteal nodes and the deep lymphatics of the hind leg, as well as the efferents of the superficial inguinals mentioned above. Its own efferent passes through the inguinal canal to end in the next node, the common iliac (see figure 1).

3. *Common iliac nodes.* Comparatively large and lenticular in shape, these two nodes lie, one on either side of the midline, at the brim of the pelvic cavity and at the bifurcation of the great abdominal blood vessels. They receive direct lymphatics from the superficial and deep inguinal nodes; and from the hypogastric nodes, which lie in the pelvic cavity at the origin of the hypogastric artery and receive vessels from the bladder, seminal vesicles and popliteal nodes. Since some of the lymphatics of the hind leg run to the superficial inguinals, which in turn send efferents to both the deep inguinals and common iliacs; and since all other lymphatics of the hind leg run directly either to the deep inguinal or the popliteal nodes and these latter send efferents to the deep inguinal and hypogastric nodes, both of which continue their efferents to the common iliac nodes, it is at once apparent that the common iliac nodes receive practically the entire lymph stream from the hind legs, the pelvis,[1] and the cutaneous and subcutaneous tissues of the abdominal and perineo-pudendal regions (lymphatics of the two latter areas all drain to the superficial inguinal nodes).

It is important, therefore, to remember that the common iliac nodes form one of the two or three great collecting points of the body and that all particles, which enter the lymphatics from a large area of the body, will, if they continue their lymphatic course, finally reach these nodes, there to be arrested or to pass through them (see figure 1).

The lymphatics of the hind leg can be easily followed as far as the common iliac nodes and beyond, if one injects a suitable mass like india ink by inserting the needle into the pad of the foot. The lymphatics from the superficial and deep inguinals are best brought out by tying off the lymphatics proximal to the common iliac nodes and then making a retrograde injection by inserting the needle into the common iliac nodes.

4. *The plexus and nodes of the abdominal aorta.* Efferents leave the common iliac nodes and at once break up to form a very rich plexus around the abdominal aorta. This plexus continues until it ends in the

[1] According to Hashiba an inconstant number of efferents from the hypogastric nodes passes directly to the plexus of lymphatics that is cephalic to the common iliac nodes and thus skips the latter.

cisterna chyli which is situated behind the aorta between the pillars of the diaphragm. Along this plexus are interpolated numerous nodes of varying size. Most of them are very small, and the largest are several round nodes just below and above the level of the renal artery and from 1 to 2 mm. in diameter. Hashiba classifies all these nodes as superior, medial and inferior abdominal aortics; and calls those at the level of the renal arteries the medial nodes. Other authors, referring particularly to these so called medial nodes, call them preaortic or paraortic nodes. None of the abdominal aortic nodes are very prominent. They are probably much more numerous than is usually apparent, for when animals were infected with tubercle which involved the lymphatic system, I have at times noticed a far greater number of these proliferating structures than would have been visible upon ordinary inspection of a normal animal. These nodes receive lymph from the abdominal viscera and the kidneys, as well as all that is converging toward them from the hind part of the body.

5. *The thoracic duct.* The cisterna chyli is continued in the thorax as the thoracic duct. According to Hashiba the thoracic duct may present one or another of four different types: (1) a single large sacculated trunk on the right side of the aorta, which in the upper part of the thorax crosses to the left of the midline to lie dorsal to the aorta; (2) two distinct vessels, one on either side of the aorta which join behind the arch of the aorta; (3) two distinct vessels connected by delicate anastomotic communications behind the aorta; and (4) a continuous network dorsal to the aorta, without a main trunk but terminating in a single vessel.

The thoracic duct ends on the left side at the junction of the external and internal jugular veins, where the lymph is poured into the blood.

The duct, therefore, conveys to the blood all the lymph from the body that drains from all points that lie approximately caudal to the diaphragm. In addition it receives and discharges into the blood lymph received from the efferents of the deep cervical nodes of the left side and the efferent plexus of the nodes of the internal mammary artery of the left side. The deep cervical nodes, of which there are several on each side, receive all the lymph from the head and neck. The nodes of the internal mammary artery, located internal to the first rib and sternum (and sometimes called the retrosternal nodes) drain the diaphragm and intercostal spaces, and *also receive some vessels from the tracheo-bronchials.* The thoracic duct therefore is the conveyer of all body lymph except that from the skin of the thorax: that from the right side of the diaphragm,

head and neck; all lymph from the right tracheo-bronchial nodes and most of that from the left tracheo-bronchials, the areas of drainage of which are about to be described; and all lymph from the forelegs. The lymph from the right side of the head and neck reaches the blood at the junction of the right internal and external jugular veins by way of the efferent of the right deep cervical nodes. That from the forelegs and thorax is discharged on both sides at the junction of the subclavian and external jugular veins by efferents from the axillary nodes and the axillary nodes of the first rib.

6. The tracheo-bronchial lymph nodes. In these nodes I would include not only the tracheo-bronchial nodes proper, but also the inter-bronchial node. The inter-bronchial is a single node lying at the bifurcation of the trachea, below the roots of the bronchi. It receives vessels from the heart and lungs, and sends all its efferents to the tracheo-bronchial nodes proper. These latter nodes are in the angles between the trachea and bronchi. They receive lymphatics from the heart and lungs and lower part of the trachea. Their efferents run to the nodes of the internal mammary artery, the axillary nodes, the axillary nodes of the first rib, and to a plexus in front of the innominate vein. The efferents of the internal mammary node end on either side in a complicated plexus on the innominate vein: the plexus on the left side joins with the thoracic duct; that on the right with the cervical and subclavian lymph trunks before entering the vein. The axillary nodes send efferents to the axillary nodes of the first rib, as well as direct vessels to the junction of the subclavian and external jugular veins. The axillary node of the first rib also sends all its efferents to the junction of these veins. The tracheo-bronchials therefore have some of their lymph discharged directly into the thoracic duct by way of the left innominate plexus and into the cervical and subclavian trunks by the right plexus; while between these nodes and the blood, several of their efferents are intercepted by the nodes of the internal mammary artery, the axillary nodes and the axillary nodes of the first rib.

The tracheo-bronchial nodes are comparatively large and prominent in the guinea pig, and stand out even upon cursory dissection. Nothing can be more certain than that they drain only the lungs and heart: *they receive no efferents from the deep cervicals and thus cannot receive lymph from the head and neck.* So far as can be made out in the guinea pig there is not even a direct or indirect communication. *efferent from the tracheo-bronchials to the deep cervicals*, a condition that has been described in other animals as, for instance, man (7).

7. The lungs. The guinea pig lung, unlike that of man, but like that of the rabbit, has a thin pleura, from which fibrous projections do not dip down into the lung to mark out secondary lobules. It has an unusual amount of muscular tissue in the walls of the bronchi and blood vessels and at the distal ends of the ductuli alveolares.[2] This heavy bronchial and vascular musculature is well brought out in figure 4 of Willis's study of this series (8). This figure also strikingly displays another prominent feature of the anatomy of the guinea pig lung, namely, the enormous calibre of the peribronchial and perivascular lymphatics which is especially noticeable here in the adventitia of the pulmonary artery. These large lymphatics seem to be a regular and constant feature in the guinea pig lung. I have noted them frequently, and found them everywhere throughout the organ in going over a series (800 sections) of a whole lung. It is, of course, at once suggested that the lymphatics stand wide open because the great musculature of the middle sheaths of the vessels and bronchi contract to an unusual extent upon the death of the animal or the fixing of the lung. Yet, even though this is true, it shows the possibilities during life, and indicates that under ordinary physiological conditions the intrapulmonary lymphatic channels accommodate a large amount of lymph which drains through the lung toward the hilum nodes with ease.

A second striking feature of the lymphatic anatomy of the guinea pig lung is its relative paucity of intrapulmonary lymphatic tissue. All mammalian lungs, that have been studied, contain variable amounts of lymphatic tissue (9) which is situated in the course of the lymphatic stream at the bifurcations of bronchi, arteries and veins. In the normal guinea pig the microscope will not reveal this tissue in very noticeable amounts until (working from the periphery) we approach the larger blood vessels and bronchi near the hilum.

We have, therefore, in the guinea pig, lungs which are furnished with unusually many and large lymphatic vessels, yet with very little lymphatic tissue to intercept these channels which proceed from periphery to hilum. As concerns the lymphatic system, the main impression that one gets is that here we have an unusually pervious or (if one may use the expression) "wide-open" lung, and that lymphatic drainage must be relatively active and free. Coupled with this condition are extraordinarily large and prominent extrapulmonary lymph nodes at the hilum,

[2] For an anatomical description of the elements of the lung see Miller.

and there receiving all lymph that comes from the lungs. Moreover, the musculature is so abundant and so active that it is not uncommon to experience great difficulty in completely distending a lung with fluid or air by injecting it through the main bronchus under pressure: for spasm of some bronchus often ensues which shuts the passage tight and prevents the ingress of the injected material. This is in direct contrast with what occurs under similar conditions in, say, the rabbit.

Willis (8) has shown that the origin of the bronchial artery is normally different from that described for any other mammal; this fact is probably not important in relation to the infection experiments that are to be described. He has also demonstrated that anastomotic communications between the pulmonary and bronchial arteries are regular features of normal guinea pig pulmonary anatomy; and he has found that whatever intrapulmonary lymphatic tissue exists in the guinea pig is supplied by the bronchial artery.

8. The spleen. The spleen of the guinea pig is a small, oblong and much flattened organ, having an average length of about 2 or 2.5 cm. and a breadth of about 1 cm. It lies in the usual splenic position. Its most striking superficial feature is *the prominence of its Malpighian bodies.* These are so large that they not uncommonly give the surface of the spleen a rough appearance. In no other animal have I ever seen the Malpighian body tissue so relatively abundant and preponderant. Since the Malpighian bodies are true lymphoid nodules in the adventitial coats of the arteries, it follows that the guinea pig spleen is *exceptionally rich in lymphoid tissue and, indeed, lymphoid nodules.*[3] The significance of this anatomic feature will be discussed in detail when we come to consider the focalization of tubercle bacilli. For the present it is enough to point out that in this respect the guinea pig differs greatly from several other mammals. In man the Malpighian bodies are not plentiful, and, compared to the guinea pig, are relatively very small. The same may be said of the rabbit: the surface of its spleen is smooth and Malpighian bodies are inconspicuous.

In the guinea pig the proper lymph node of the spleen (if there is one) is so inconspicuous that it has escaped the attention of all authors whose work I have consulted: nor have I been impressed by it. It is

[3] Throughout the animal body are innumerable collections of lymphoid tissue, varying from a very few cells to comparatively large masses. Before a mass of lymphoid tissue, however, can be classed as a lymph node or nodule, it must possess germ centres, which are distinguishing characteristics of all true lymph nodes.

nevertheless most likely that the spleen's efferent lymphatics proceed to the superior members of the numerous nodes of the abdominal aorta, or empty directly into the rich lymphatic plexus that surrounds this vessel (see figure 1). I base this opinion on the lymphatic drainage of the spleen as it has been worked out in man (10). Here its efferents run to the pancreatico-splenic nodes, the efferents of which proceed to the coeliac nodes, in front of the abdominal aorta and around the origins of the coeliac axis and superior mesenteric artery. The coeliac nodes receive efferents from the gastric, hepatic, pancreatico-splenic and mesenteric nodes. They send their efferents to the cisterna chyli or, more usually, these form a common trunk, the truncus intestinalis, which joins the left lumbar trunk to form one of the origins of the thoracic duct.

9. The liver. While the node of drainage of the spleen is apparently insignificant, all authors have been struck by the prominence of the "liver node." By many it is termed the "portal node," but Hashiba gives it the more correct designation of retropancreatic node, which sufficiently defines its position. All lymph from the liver drains to this node, which then sends its efferents to the higher abdominal aortic nodes or the abdominal aortic plexus. In man the efferents from the hepatic nodes run to coeliac nodes, mentioned above, which also receive the lymph from the pancreatico-splenic nodes, which in turn drain the spleen.

Intrahepatic lymphoid tissue is not conspicuous enough to arrest attention.

10. Summary. In the guinea pig, therefore, the superficial lymph nodes and those of the pelvis, abdomen and thorax are unusually abundant and prominent. The lungs have intrapulmonary lymphoid tissue, but *this is relatively slight, and is concentrated near the hilum;* on the other hand the tracheo-bronchial nodes, which drain the lung, are unusually large and conspicuous. By way of contrast, the intrasplenic lymphoid tissue is excessive, yet, the spleen's tributary lymph node is not well defined. The amount of lymphoid tissue in the liver is not unusual, but the latter's lymph node stands out. One is almost tempted to put forward the generalization that, as regards any particular viscus, the amount of its extravisceral lymphoid tissue will be in inverse proportion to that existing in the viscus.

At the same time the leading anatomic (microscopic) impression that one gets from a study of the guinea pig's lung is that lymphatic circulation (drainage) can proceed with the utmost facility. Perivascular (adventitial) and peribronchial lymphatics are enormous,—relatively much

more widely open and much larger than, under the same circumstances of preparation of specimens, is to be observed in other animals. Because, too, of the small amount of intrapulmonary lymphoid tissue, there is little in the course of the lymph vessels to intercept foreign particles in the lymphatic stream of the lungs.

PERTINENT FEATURES OF THE LYMPHATIC AND BLOOD DISTRIBUTION OF FOREIGN PARTICLES

The studies that form the basis of this contribution concern the time and dosage relations of dissemination, the avenues of distribution, the sites of localization and the factors that determine the localization of living tubercle bacilli in the guinea pig. Before entering into their description and analysis, it will undoubtedly contribute to their appreciation if we first discuss from a more or less theoretical point of view, and on the anatomic basis that we have erected, certain possibilities regarding the normal distribution of foreign particles in the guinea pig body. In almost all of our experiments the introduction of tubercle bacilli was performed by subcutaneous inoculation into the groin (usually right side). The subcutaneous tissue at this point shall therefore serve as the starting point of the transportation of foreign particles throughout the body. The author is aware that an injection made into this region by needle may, *theoretically at least*, carry particles immediately into blood vessels and thus introduce them into the general circulation. This point will be taken up later and its actual occurrence determined in the light of all the data brought to light by the infection experiments. For the present, for the purposes of simplyfying the exposition as muc as possible, it is assumed that all particles are first deposited in the tissue spaces, that is, in the domain of the lymphatic system.

1. The site of injection. If one makes a subcutaneous injection of inert foreign particles, *most of the mass remains localized at the site of injection.* I have had numerous occasions to observe the disposition made of foreign particles, after the injection of such substances as animal charcoal or suspensions (water) of pulverized india ink. Though I have not had the opportunity to confirm it scientifically, it is my impression that if large amounts of foreign particles are injected, relatively greater proportions of the material remain *in situ* than after the introduction of minute quantities. A more intense and widespread local reaction follows the injection of the larger amounts; and this of itself tends

to localize the particles more completely and to wall them off better from the lymphatic system. The type of reaction will, of course, also depend on the irritating qualities of the mass.

At any rate, the greater part of the material remains in the spot where it was put. But, if one examines individuals of a series of injected animals day by day, one soon observes that some of the particles have been carried some distance away from the site of injection and are now coloring members of the chains of lymphatic nodes that are central and tributary to this site. The nodes that are immediately in the path of lymphatic drainage of the spot are more deeply colored than those which are further away: as we go from periphery to centre we find the color of the nodes becoming fainter and fainter, until it finally disappears from the unaided vision. In other words, there are more pigment granules in the nodes that are closest to the injected mass. In other words, too, the granules have got from tissue spaces into the closed channels of the lymphatic system. No stretch of the imagination would conceive that in the act of injection the needle slipped neatly into a tenuous lymphatic and thus inserted particles into the closed lymphatic system. And the first question of major importance that confronts us is: How did the foreign particles get into the lymphatics?

2. *The entrance into the lymphatic system.* We cannot speak accurately on this all-important point. We really have no exact information concerning the physiology of the lymphatic circulation at its origin,—at the periphery: information concerning the intercellular pressure (that is, that of the tissue juices or fluids in the tissue spaces) or the differences in pressure between that of the intercellular fluids and that of the beginning of the lymph stream, etc. *There is, however, no normal centrifugal lymph circulation:* so much is certain, and we must assume that physiological conditions (no doubt promoted by muscular movements, by an unknown *vis a tergo*, etc.) are such that they induce a pressure and velocity of the lymphatic circulation which carry the lymph centralwards (centripetally) from the periphery of the body. As soon as we arrive at lymphatics of any size we meet with valves that prevent the reflux of lymph; and their presence, as in the venous system, indicates that in these places pressure is diminishing as compared to the periphery.

Though we cannot accurately describe the passage of foreign particles into the lymphatic circulation, we can attempt to build up a succession of probabilities that may approximate the truth. We know to a certainty that inert foreign particles cannot propel themselves: and we can

imagine only two methods which might carry them into lymphatics. One is a body fluid current of sufficient force to sweep them naked past lymphatic walls and into the channel. This is hardly likely. Another is the intervention of some medium which is capable of self-movement and which at the same time can carry particles and can enter (and leave) closed vessels.

The existence of a medium that fulfills the latter conditions has long been recognized. So called phagocytic cells, particularly polymorphonuclear leucocytes, are endowed with locomotion: they can ingest foreign particles, they can move into and out of closed vessels, and they can wander about in the tissue spaces. In the present state of our knowledge we can think of no other mechanism than the intermediation of phagocytic cells which would carry particles into lymphatics.

I have mentioned that a relatively larger proportion of an injected mass remains *in situ*, if the amount of the mass is large and the reaction is correspondingly more intense and extensive. Only those particles can be transported that are available to the phagocytic cells, and the more the particles are hemmed in by a granulation tissue which later organizes the fewer (relatively) will be accessible to phagocytes.

3. The transmission from the periphery to the blood stream. After we inject pigment granules into the subcutaneous tissue of the right groin, then for a few days we find only the immediately adjacent nodes pigmented. But, little by little, nodes that are more central take on a certain amount of color. The time comes when the process no longer progresses, and after a while the nodes may lose some of their color and become paler.

Since the inert foreign particles are incapable of reproduction, we must assume that color gradually becomes visible and more pronounced in successive nodes because particles either are with slight interruption being carried through from original focus (site of injection) to distant nodes, or are being dislocated from more peripheral nodes and then transported to more central ones. Unless lymphatic channels become blocked by an accumulation of granules, there is no reason not to suppose that both the above methods of conveyance occur. It would also seem that once in the lymphatic current particles can be moved along, nakedly or contained in phagocytes, by the force of the stream.

From superficial inguinal to superior abdominal nodes we note a gradually fading color as we go from node to node: the amount of pigment becomes less and less as we approach the centre. This, in short, is

the situation if the pigment is deposited subcutaneously in the tissue spaces (the lymphatic domain), and lymphatic "drainage" is allowed to pursue its natural course.

If, however, we inject directly into a peripheral lymphatic or a lymph node and exert high pressure in making the injection, we can at once and very rapidly fill all nodes with pigment.

In either event, as long as the lymphatic paths are unobstructed and open central to the point of injection, the pigment will strictly follow a course up the abdomen and thorax that is represented by the common iliac and abdominal aortic nodes of the side on which the injection is made, and then the cisterna chyli and thoracic duct. There is no flowing over into the "portal" node and the lymphatics of the liver, or the lymphatics of the kidneys, spleen and gastro-intestinal system. If high pressure is exerted at a distance, as into the foot-pad, the abdominal chain of nodes and lymphatics and the cisterna and thoracic duct may at once be filled; but, to my observation, no reflux has ever occurred into afferents that empty into these places whether these afferents were those coming from the groin (the superficial inguinals) or from the abdominal viscera. In view of the paths that have at various times been put forward as determining the distribution of tubercle bacilli, it is important to appreciate the full significance of this circumstance, that is, that an immoderately high pressure, artificially applied, has not sent the injection mass into the incoming vessels of the central abdominal nodes and lymphatics.

All particles that pass through the thoracic duct must get into the venous system and, proceeding immediately through larger and larger vessels, enter the right side of the heart and thus the lesser circulation.

4. The passage to, through and in the lungs. The lungs will receive all foreign particles that enter the venous circulation. *They thus constitute a converging point for all the particles that proceed from periphery to centre whether these start in lymphatics and pass all intercepting nodes or enter a vein directly:* and, in this respect, when compared with other viscera, they are unique. If all particles became arrested in the finer blood vessels of the lungs, we should, of course, expect to find all blood-borne infections confined *at first* to the lung. But there is abundant experimental evidence to prove that many, perhaps most, intravenous particles pass through the pulmonary capillaries and are then distributed *dispersively* throughout the body by the general arterial circulation.

Oettinger (10), working in Flügge's laboratory, is one of the more recent authors to report the immediate localizations of foreign bodies after intravenous injection. His methods while somewhat crude represent one of the few attempts to make quantitative estimations. He would inject rabbits intravenously with emulsions of various types of easily identified microörganisms, and from one to four hours later would remove particles of several organs, crush these, make suspensions of the material and plate the suspensions. As specimen protocols we may extract the following: (1) One hour after intravenous injection of B. prodigiosus, the count of a removed particle of lung was 50; that of a similar bit of liver, 120,000; and of spleen, 13,000. Four and one-half hours after injection the counts for lung, liver and spleen had dropped to 8, 48, and 320 respectively. (2) One hour after injection of staphylococcus albus the counts for lung, liver and spleen were 200, 28,000 and 28,000: four hours after injection they were 24, 1200, and 1200. Oettinger tabulates other experiments; but these are enough to show plainly that the lung capillaries by no means arrest all or the greater number of particles that enter them, an opinion expressed by Borrel (12) and implied by Aufrecht (13) and Cornet (14). We cannot stop at this point in our inquiry to discuss the cause and the meaning of the great decrease of microörganisms in the various organs between one and four hours after injection: we shall come back to these points later. For the present we would only emphasize that many particles introduced into the circulation pass through the capillaries of the lungs.

But not all particles pass through. And of those which are arrested in the capillaries, what of them?

They can be disposed of in only one or the other of two possible ways, namely: they either (1) remain in the capillary *in situ*, or (2) they are carried out of the lumina of the blood vessels by phagocytic cells. If they meet with the latter fate they once more enter the domain of the lymphatic system, when they may be deposited in the tissue spaces or carried into the lymphatics of the lung. If they enter these lymphatics they will again be propelled centralwards toward the tracheo-bronchial nodes, and will at last reach these nodes unless they are intercepted in their course. They will suffer the same disposition as particles which are inhaled, which is described by Schäfer (15) as follows:

The lymphatics of the lung often contain large mononuclear leucocytes (phagocytes) with carbon particles in their interior. These particles are

conveyed to and deposited in the connective tissue of the lung, especially in those parts which contain *lymphoid tissue* (italics the author's); some of them are carried to the bronchial glands at the root of the lung. Such particles scattered about in the interlobular connective tissue give a slaty-gray appearance to the organ. The carbon particles are introduced with the air of respiration and appear to be conveyed from the interior of the alveoli into the pulmonary tissues by the agency of leucocytes, which are often seen, in sections of lung, within the air-cells.

Miller (9) has made a study of the distribution of the lymphoid tissue in the lungs of various mammals; and from his paper I quote the following points:

The distribution of lymphoid tissue within the lung . . . . has been passed over lightly in general descriptions of the histology of the lung . . . . Arnold (16) . . . . established it as a constituent of normal lung. . . . . Oppel (17) has found lymphoid tissue in the bronchi of representatives of the vertebrate phylum from monotremes to man. . . . . The most interesting sections I have studied were taken from the lung of a common brown rat which was caught in the coal bunkers of a large steam heating plant. Figure 12 shows a portion of a section of the lung in which phagocytes in various stages of activity are seen more or less laden with pigment. Some of these are free within the alveoli, others are within the walls of the alveoli while still others have found their way into the mass of lymphoid tissue where they have deposited their contents. Lymphoid tissue . . . . may be peribronchial, periarterial, perivenous or subpleural . . . . in the form of lymph nodes, lymph follicles or small masses of lymphoid tissue. . . . . The smaller masses . . . . may, like the lymph nodes, act as filters interpolated in the lymph circulation. They also serve as centres to which the phagocytes carry their collected material.

Particles which are carried out of blood vessels would undoubtedly meet the same fate as those which are carried through alveolar epithelium into the pulmonary tissue. They will "drain" to the tracheo-bronchial nodes if the way is open: if it is not, they will be arrested in the course of the lymphatics by lymphoid tissue. We would expect, therefore, *that the amount of pigment that remains in the lungs will depend directly on the number and size of the collections of lymphoid tissue in the lung, while the amount that goes to tracheo-bronchial nodes will be inversely proportional to the number and size of these collections.*

I have already mentioned (p. 142) that in the guinea pig the amount of lymphoid tissue is very small, and that the lymphatics are relatively

enormous, the tracheo-bronchial nodes unusually prominent and the intrapulmonary musculature extraordinarily heavy,—all features that point to an exceptionally active and unobstructed intrapulmonary lymphatic circulation. As a matter of fact, all experiments on the inhalation of dusts by guinea pigs, especially the more recent ones by Mavrogordato (18), bear out this opinion. It is not difficult to find dust throughout the guinea pig lung, if the animal is killed immediately after exposure to a dusty atmosphere. But, if the animal is killed several weeks later, then dust can no longer be detected *in* the lung: it has all been carried to the tracheo-bronchial nodes, where it can be easily seen. Only after very prolonged exposure (months) will dust remain permanently *within* the tissues of the lung. Mavrogordato also believes that much of the *intrapulmonary* dust is eliminated by phagocytes which again carry it *out* of the interstitial tissue into the air passages; but, until this mechanism is definitely disclosed, its existence must be considered very questionable.

By way of summary, therefore, particles that reach the lungs by way of the blood,[4]—*and this is the only route by which particles that are introduced subcutaneously can enter the lungs*,—may (1) pass through the capillaries and thus attain the general arterial circulation; (2) be arrested in the smaller blood vessels (most likely arterioles or capillaries) and remain *in situ;* (3) after stopping in the latter places, be carried through the vessel intima and be again in an area of lymphatic drainage; (4) remain anywhere in intrapulmonary lymphatics; (5) be carried centralwards to intrapulmonary lymphoid tissue; or (6) get to the tracheo-bronchial nodes. The relative perviousness of the lymphatic stream in the lung will largely determine the facility of drainage to the nodes.

5. The passage from the periphery to the tracheo-bronchial nodes. After this long discussion of the possibilities of conveyance to and through the lung it need hardly be pointed out that the amount of material that reaches the nodes depends almost entirely on the amount that is thrown into the lymphatic circulation of the lungs.[5] All recent investigations establish beyond a doubt that these nodes receive lymph from the lower part of the trachea, the lungs and the heart, and *from these places alone*

[4] Distribution by the bronchial artery is purposely neglected, in order to narrow and simplify the exposition.

[5] While the tracheo-bronchial nodes drain the heart, this source of supply of foreign particles can be disregarded as relatively negligible, as may also the proper arterial blood supply of the nodes.

(see especially Most (7) and Hashiba (6)). To get to tracheo-bronchial nodes particles must first enter the pulmonary and lower tracheal lymphatics by one or the other of two routes, namely, (1) either by penetrating the epithelial lining of the air passages, or (2) by emerging from the lumina of the blood vessels. In either case they at once come to lie in tissue spaces from which they may be conveyed to lymphatics and thence to tracheo-bronchial nodes.

6. The passage from the periphery to the spleen. It is manifest that particles that enter the peripheral lymphatics can reach the spleen in only one way. This is by its proper artery of supply. The intermediary route must be as follows: (1) by the lymphatics into the venous system; (2) by the latter to the right side of the heart, and thence through this and into the pulmonary arteries; (3) by these into the lungs, through the pulmonary capillaries and to the pulmonary veins; (4) by the latter to the left side of the heart and into the arterial system of the general circulation.

The spleen is a comparatively remote and isolated organ. Its blood supply is probably no greater than that of several other important viscera,[6] as, for instance, the lungs, liver, kidneys and brain; and we would presume that at any particular moment it would receive no more blood than any of these organs. If this is the case, it is likewise true that it would have brought to it no more foreign particles by the systemic circulation than would the other organs. If, therefore, it should happen that the spleen regularly exhibits more numerous or more extensive foci of a generalized infection—as, for instance, tubercle—than do other organs that have equal or greater opportunities (as regards numbers of bacteria) for infection we must assume that there is something inherent in the spleen that favors localization or development of the infection. This particular matter will receive more exhaustive attention in another study.

7. Localization in and passage through the spleen. As is the case in the lungs (if particles are blood-borne), there are two conceivable methods of the latters' localization in the spleen; they may lodge in a finer blood vessel and remain there; or, after being temporarily arrested in a blood vessel, they may be conveyed out of its lumen. In the latter event, having now gained the lymphatic domain, they may lodge in tissue

[6] While at its origin the splenic artery is very large,—larger, in fact, than either of the other two branches of the coeliac axis,—before it enters the spleen it supplies branches to the stomach, the great omentum and the pancreas.

spaces, or be carried into lymphatics. Once in lymphatics they will follow the course of the lymph circulation and will either (1) be arrested finally in the intrasplenic lymphatic tissue (Malpighian bodies) or (2) after temporary lodgment in these be carried further in the lymphatics, —to the efferent vessel of the spleen, the paraortic plexus and thoracic duct,—and by these again into the blood circulation to experience anew the multiple possibilities of the blood circulation; or (3) make this continuous lymphatic transit without tarrying in any lymphoid collections. In this place, and in view of certain lymphatic routes that have been assumed by some authors to explain the localization of tubercle in several places, it may be emphasized *(1) that there is normally no direct or indirect afferent lymphatic connection from the great plexus of the abdominal aorta to the spleen: and (2) that there is no direct or indirect efferent lymphatic path from the spleen to the hepatic (portal) node.* We may here anticipate our subject in respect to our proposition. It can be abundantly proved, and in another study the data will be brought forward to show, that those blood-borne particles (tubercle bacilli) to the lungs that become arrested in the small vessels, are very rapidly carried out of the latter and may soon be found in tissue spaces and the lymphatics of the vascular adventitia. If this is true of the mechanism of localization in the lungs, it is reasonable to assume that the same event occurs in the spleen (or any other organ or part of the body).

All particles which come to the spleen by its artery and are not "caught" in its blood vessels, continue through these and at once proceed to the liver by the splenic and then the portal vein.

8. The relation of the liver to blood-borne foreign particles. In this description particles that may conceivably reach the liver by way of the portal system after digestion will be disregarded and the exposition apply only to those that have first gained the systemic circulation,—as after discharge from the thoracic duct into the venous system.

The quantitative possibilities of the liver as regards its reception of blood-borne foreign particles should be fully appreciated. By the hepatic artery there enter the liver all those particles which are properly the "share" of this artery after material has passed through the capillaries of the lungs. At the same time the portal vein conveys to it all particles which first pass through the pulmonary capillaries, are then distributed to pancreas, gastrointestinal tract, and *spleen*, and likewise traverse the blood vessels of these later organs. Distribution to the lungs is mainly convergent; to the splanchnic area (that in the supply of the

coeliac axis) it is wholly divergent; to the liver it is partly divergent (by the hepatic artery) and to a large extent convergent (by the portal vein). The number of foreign particles brought to any ordinary organ of the body, except the lungs and liver, must stand in direct ratio to the relative amount of arterial blood which is its portion, and after these particles have been roughly "filtered" out by the smaller blood vessels of the lungs. The number of those that reach the lungs includes all that attain the entire systemic venous circulation. The number that come to the liver is a combination of those borne by its artery after they pass through the lungs and those from a very large and important domain of the body after they have traversed both lungs and the organs in this domain. From a theoretical point of view, therefore, blood-borne foreign material should reach the lungs in greatest amount, and the liver in far greater amount than any other organ except the lungs. If the amount of foreign particles brought to the various organs (infectious microörganisms) were the sole determinant of the incident of infection and its extent, it would probably not be difficult to predict the location and quantitative character of various blood-borne infections. Experiments, then, like Oettinger's (11), mentioned above, would be more significant in their purposeful relations. But, as we shall see later, there is a wide gap between the fact that an organ is in the path of a given number of particles and the deduction that this given number *finally* localizes there.

Particles that reach the liver by the hepatic artery and portal vein will, of course, experience the same fate as those that enter any other organ by way of an artery. They will either make the entire vascular circuit of the organ or they will permanently or temporarily lodge in the smaller vessels.

If they pass through the blood vessels they will be at once conveyed back to the lungs.

If they are arrested in the liver capillaries, some may be carried out of the lumina and into the lymphatic system, to make their way along this to the hepatic (portal) node or through this to the plexus of the abdominal aorta, the thoracic duct, venous system and again the lungs.

9. Summary. Subcutaneously injected inert foreign particles set up a rapid local inflammatory reaction at the site of injection.

The degree of reaction depends on the amount and the irritating qualities of the foreign particles.

This reaction tends to localize and confine much (perhaps most) of the material injected.

Some particles are conveyed (by phagocytic cells) into adjacent lymphatics.

The lymph stream now carries them centralwards.

Intercalated lymph nodes arrest particles that are brought to them while, unless the nodes become completely obstructed, some particles may continue their transit through nodes.

After the last (most central) node is passed particles reach the thoracic duct and thence the venous system, or the venous system without the intervention of the thoracic duct (from the head, neck, forelimb, etc.)

From the venous system all particles converge toward the lungs, through which they may pass or in which they may be arrested.

If they lodge in the smaller blood vessels of the lungs, they may remain *in situ* or may be conveyed (by phagocytic cells) out of the lumina into the tissue spaces.

From tissue spaces they may again be carried into lymphatics and by these transported to intrapulmonary lymphoid tissue or hilum nodes.

Those particles that pass through the pulmonary blood vessels (without embolizing) are distributed dispersively by the systemic arteries to the several organs and parts of the body.

The spleen receives particles by way of the splenic artery alone.

Such particles may pass through the spleen by way of the blood vessels or they may be fixed in the spleen.

Those that pass through go direct to the liver by the splenic and portal veins.

Those that are fixed may remain in the lumina of the smaller vessels or be carried out of these into the lymphatic system.

In the lymphatic system they may be arrested in lymphoid collections (Malpighian bodies) or be carried further to the splenic node, the cisterna chyli, thoracic duct and venous system, whence they return to the lungs.

The liver receives particles by way of the hepatic artery and the portal vein.

It therefore has brought to it material that passes through the blood vessels of the lung, as well as material that makes the blood vascular circuit of the great splanchnic region.

Such particles may go by the blood directly through the liver and thus back to the lung.

Or they may lodge temporarily or permanently in liver capillaries, arterioles and venules. Some may be carried out of the lumina of the finer vessels into the lymphatic system.

These latter will then remain fixed in the lymphatics of the liver, or "drain" by these to or past the hepatic (portal) node.

From this node their course will be into the great lymphatic trunks, and thence to the venous system and back to the lungs.

THE MORE VISIBLE RESULTS OF THE SUBCUTANEOUS INFECTION OF GUINEA PIGS WITH LIVING TUBERCLE BACILLI

We assume—and there is not the slightest reason to question the validity of the assumption—that the normal channels of distribution and the mechanism of transportation of non-motile pathogenic microörganisms, like tubercle bacilli, are the same as those we have described for foreign bodies. In fact, it is more than likely that, by studying the effects of tubercle bacilli, we can with greater distinctness lay bare certain points where the course and transit of inert foreign bodies pass into relative obscurity.

While the paths and methods of distribution are the same for both foreign bodies and tubercle bacilli, it is at once obvious that as regards later and remote further metastasis and localization the possibilities are vastly different. All who have practised the experiment agree that both foreign particles and tubercle bacilli, if introduced in quantity into the blood circulation, disappear from it with remarkable rapidity. In other words, they are soon fixed somewhere—at many points in the body.

Now all inert foreign particles will soon be permanently confined at particular places. The tissues will react to them; and, incapable of reproduction and multiplication, and progressive necrotizing effects, they will not form depots from which successive generations may be mobilized and spread further. But living tubercle bacilli do form such depots. As long as bacilli remain alive and as long as the natural paths of distribution persist unobstructed, there is always the likelihood of an increment of infection at points to which the paths converge and a dispersion of bacilli from these latter points. Lymphatic transmission or ulceration into a vein will bring about convergent (centralward) distribution. Ulceration into sytemic arteries will cause dispersive distribution. Tendeloo (19) is of the opinion that this latter type of metastasis may occur without ulceration. He thinks that cheesy tubercles may project into arteries and "bacilli penetrate through the intima just as they get out of a cheesy focus with thin, non-fibrous wall into the neighborhood, although there can be no claim that the focus has broken through."

If inoculation of human tuberculosis is performed into a guinea pig's thigh, its effects develop in the following order. The local wound (*l'accident*) is insignificant. It is composed merely of several small, yellowish granulations, if the inoculated matter is pure. But, if pyogenic substances have been introduced with the tuberculous material, the wound presents itself as a purulent ulcer (*clapier*). Nevertheless, the consecutive progress of the lymphatic infection differs but little in either case. About fifteen days after the insertion of the virus, the inguinal nodes of the inoculated side begin to swell, and this is then a certain sign that the animal will die of tuberculosis. At about the twentieth day, the iliac nodes (*les ganglions sous-lombaires*) of the same side are in turn affected, while the entire lymphatic system of the opposite side remains perfectly healthy. Between the twenty-second and twenty-fifth days tubercles appear in the spleen, at the same time that the hepatic node (*le ganglion retro-hepatique*) becomes enlarged. Following this, the virus crosses the diaphragm and its dissemination no longer preserves its unilateral character. The lungs and bronchial nodes become indistinctly tuberculous. At about two months tuberculization is general; and at length it also appears in the iliac and inguinal nodes of the side opposite the inoculation. In a guinea pig that has been inoculated in the thigh, the evolution I have indicated is so constant, that from the animal's lesions one can determine the place and date of inoculation, from the point where invasion of the lymphatics has ceased.

The above description, written almost thirty years ago, is by Arloing (20). It will serve as a concise account of the roughest outlines of the most superficial sequelae of subcutaneous infection in the guinea pig. It is an average picture: after infection with large doses the inguinal nodes will swell before the fifteenth day, while after very small doses palpable tumefaction may be delayed until three weeks have elapsed. Twenty days is too late a time to set for the appearance of the first visible changes in the iliac nodes; these appear by the end of two weeks in most cases. Microscopic tuberculosis of the spleen is not uncommonly delayed until the end of the fourth week. The Malpighian bodies of the guinea pig spleen are normally very prominent. In many healthy spleens they may be unduly prominent and delude the observer; for tubercle of the spleen may in its early development appear as enlargement of the Malpighian bodies; and I have now and again seen a dispute as to the presence of splenic tubercle settled only by resort to the microscope. If nodules are discrete or if an occasional Malpighian body is manifestly larger than the others, we are usually correct in calling the spleen tuberculous, that is, if tubercle is present elsewhere in the body: but when

more or less general hyperplasia of the lymphoid tissue exists caution must be exercised in diagnosis.

Arloing does not mention infection of the liver in this description and by implication associates involvement of the hepatic node with disease of the spleen. The features of infection, as they impressed him, are the slight local (inoculation) reaction; the tardy development of lesion in the regional nodes, followed by an orderly sequence of progress up the lymphatic chain; *the early involvement of the spleen with coincident swelling of the hepatic node; the indistinct tuberculization of the lungs and tracheo-bronchial nodes;* the early restriction of lesion to the retro-abdominal lymphatic chain of the same side as the inoculation; and involvement of lymphatics of the other side only after dissemination becomes general. What is particularly striking is that he noticed the tendency for tubercle to localize in the spleen, while the lung is relatively spared.

Several of these features that Arloing noticed have been the subjects of experiment and analysis, and will be taken up in turn in the following treatise. Matters that will receive the most exhaustive attention are infection of the lungs and its relation to infection of the tracheo-bronchial nodes. Another major problem, to be considered in a later study, is infection of the spleen and its relation to infection of the hepatic node. Subsidiary points of interest which will be discussed are the local (subcutaneous) reaction to inoculation and its relation to infection of the inguinal and iliac nodes. The dependence of one organ upon another as regards infection has stood out prominently in our studies and will receive consideration. Since such possibilities as those regarding the rate and course of dissemination of tubercle bacilli in the animal under observation must be understood before any sound interpretation of the course of infection is permissible, these were investigated by experiment; and their details, results and applications will be set down first.

THE RATE OF DISSEMINATION OF TUBERCLE BACILLI AFTER PRIMARY SUBCUTANEOUS INOCULATION OF THE GUINEA PIG

There are few experiments on record which have approached this problem in a way that is reasonably free from criticism. An early attempt to determine the rapidity of the spread of tubercle bacilli in the guinea pig was by Arloing (20). Five days after subcutaneous (groin) inoculation of four guinea pigs with human tubercle he removed the inguinal chain of nodes from two. When he killed the four animals two months later, he found all to be equally tuberculous.

This result showed Arloing that before the sixth day after inoculation lymph nodes which were normal to the eye and touch had failed to arrest all bacilli in the region that was tributary to them; and he concluded that "the transport of tuberculous virus by the lymphatics was in general rapid."

In 1907 Oehlecker (21) reported experiments that were more satisfactorily planned. After a preliminary experiment he inoculated 5 guinea pigs in the right groin with a small loop of an emulsion of human tubercle bacilli. On the third, fifth, seventh, eleventh and fourteenth days, he killed individual animals and removed their iliac, paraortic and tracheobronchial nodes, spleen and lungs. He inoculated each organ (or a large part of it) in turn into normal guinea pigs; and by this method discovered that in his first 5 animals tubercle bacilli had not reached any of the removed organs by the third day. On the fifth day, however, they were shown to be present in the iliac nodes, lungs and spleen, though still absent in the paraortic and tracheo-bronchial nodes. By the seventh day they were also demonstrated in the paraortic nodes, while the tracheo-bronchials were still free. On the eleventh day they had appeared in the latter nodes; and the circuit from periphery to centre was now complete.

The following table (table 1) taken from Oehlecker will bring out his findings more sharply:

TABLE 1

From Oehlecker: to show first day of infection of several organs after subcutaneous inoculation of right groin

WHEN KILLED AFTER INFECTION	ILIAC NODES	PARAORTIC NODES WITH PIECE OF THORACIC DUCT	TRACHEO-BRONCHIAL NODES	LUNGS	SPLEEN
On third day	–	–	–	–	–
On fifth day	+	–	–	+	+
On seventh day	+	+	–	+	–
On eleventh day	+	+	+	+	+
On fourteenth day	+	+	+	+	+

The rate and peculiarities of the spread of tuberculous infection in both the guinea pig and rabbit have engaged my attention for a long time. I was particularly interested in how long it might take the bacilli to make the entire circuit of the body, that is, from periphery and up the retro-abdominal lymphatic chain to great lymphatic trunks, to blood, to lungs, to tracheo-bronchial nodes. Other questions of interest

were whether visible infection would occur in the tracheo-bronchial nodes, yet at the same time be unobservable in the lungs; whether late metastatic infection, because of the allergy which the animal had acquired, would develop differently from early, primary tubercle; whether the anatomic character of the lesion varied in different organs,—in the lungs, for instance, as compared with a lymph node; etc.

About seven or eight years ago I began to make observations on some of these points; and in 1917 and 1918 had Dr. Lange, under my direction, perform several preliminary experiments to determine the earliest appearance of bacilli in the tracheo-bronchial nodes, after inoculation of a remote place like the right groin. A summary of the results of these first experiments has already been recorded (4): it appeared that bacilli reached the nodes from six to nine days after inoculation. Material had been removed from inoculated guinea pigs at intervals from six hours to thirteen days after infection, and had then been injected into fresh, normal animals. But the results of this first work were irregular and not entirely satisfactory; and it was determined to repeat it on a larger scale. This later experiment which follows was carried through with the assistance of Dr. Willis.

1. Purpose of the experiment. To determine the first manifestation of tubercle bacilli in various parts of the body, but especially in the lungs and tracheo-bronchial nodes, after subcutaneous inoculation of *large doses* into the right groin and to note the first appearances of lesion, both gross and microscopic.

2. Plan of the experiment. First: to inoculate a number of guinea pigs. Second: beginning four days after infection[7] to kill two animals of this series and remove from each the site of inoculation (subcutaneous tissue and superficial inguinal chain of nodes), iliac nodes, spleen, lungs and tracheo-bronchial nodes, and to note and describe carefully the gross appearance of all tissues: to repeat this procedure at intervals after four days. Third: on every "observation day," to inoculate individual normal guinea pigs (subcutaneously, right groin) with all the material from one of the several organs removed from one of the above animals, and later to observe at regular intervals the condition of such inoculated guinea pigs. Fourth: to use the tissues of the other of the two animals, above mentioned, for histological study.

[7] Four days was chosen because the earlier experiments had indicated that the tracheo-bronchial nodes were not infected until from six to nine days after inoculation.

3. *Technique of the experiment.*

a. The suspension used. Was of human tubercle bacilli, of known and average virulence (strain H 37, Saranac Laboratory). A heavy suspension was prepared from a luxuriant glycerin-agar growth, two weeks old. This was then centrifugated at the highest speed (about 3000 revolutions per minute) for one minute. The supernatant suspension which was opalescent was used for inoculation.

b. Inoculation of animals. On December 23, 1918, subcutaneous inoculation was performed into the right groin of 24 adult guinea pigs. Each received 0.25 cc. of the above suspension from a Record syringe. After the inoculation, the entire groin region of each animal was at once sealed with cotton and collodion.

c. Autopsies of animals and removal of material for injection. Animals were killed and the tracheo-bronchial nodes, lungs, spleen and iliac nodes removed for injection into other normal guinea pigs at 4, 5, 6, 7, 8, 9, and 12 days after inoculation. After twelve days the iliac nodes were noticeably involved. Their injection was therefore discontinued and at 18 and 22 days only tracheo-bronchial nodes, spleen and lungs were injected. At 26 days only the lungs and tracheo-bronchial nodes were used.

The autopsies and removal of material were performed as follows: The front, sides and legs were cleanly shaved and washed. The body was then wrapped in cloths that had been soaked in 5 per cent carbolic acid, and allowed to remain in these for from ten to fifteen minutes or longer. At the end of this time autopsy was begun at the cephalic end of the body, and only enough of the carbolized covering was removed at any one place to allow exposure of the part to be worked on. With frequent changes of freshly sterilized instruments, a small opening was first made in the front of the thorax and all tracheo-bronchial nodes carefully dissected out, washed in sterile physiological salt solution, and put in a sterilized mortar. The lungs were next dissected out with the same care; then the spleen, and finally the right iliac node.

As has been mentioned, a second animal was always killed at the same time, and the same tissues together with those of the inoculation site removed for histological study.

d. Preparation and inoculation of materials. The material of the whole of both lungs, of the spleen, of the iliac or of the tracheo-bronchial nodes was always injected into single guinea pigs. Each organ was first cut into small bits with a sterile scissors, and these ground in a mortar by

being rubbed over sterile copper gauze. The entire spleen is readily reduced to a pulp which can be injected through a needle of small calibre. But lungs and lymph nodes contain a good deal of tough, stringy tissue which cannot be so finely divided. The lungs and nodes were therefore ground a long time with a small amount of physiological salt solution and all the material from each organ that remained in suspension was used for injection. This always included almost all the solid substance of the tissues in question.

4. *The results of the injection of tissues.*

a. As indicating the rate of spread of bacilli. These injections disclosed that, with a single exception, tubercle bacilli were always present in all the tissues removed from four days after infection on. The exception was that no bacilli were in the tracheo-bronchial nodes that had come from the guinea pig inoculated five days before: the animal injected with these nodes remained free from tubercle. But all tissues,—iliac nodes, spleen, lungs and tracheo-bronchial nodes,—from the guinea pig that had been infected in the groin four days before produced tuberculosis in the animals into which they were injected. *Four days, therefore, after bacilli had been introduced into the subcutaneous tissue they had traversed all lymphatic barriers, had got from the lymph stream into the blood, had passed by the blood into the lungs, had left the lumina of the smaller blood vessels of the lungs, had gone into the pulmonary lymphatics and had by these been carried to the tributary tracheo-bronchial nodes.* From detailed observations that were made and will be given later, it is unlikely that the transit to lungs was direct by way of the blood and initiated by bacilli being inoculated into capillaries of the groin, nor is it admissible to suppose that the tracheo-bronchial nodes were for the most part infected by their own artery of supply.

These inoculations were made with very large doses of bacilli and were performed more with the idea of determining possibilities than to attempt to reproduce "natural" conditions. How much earlier than four days bacilli can make this complete circuit of the lymphatic and blood circulations,—as from tissue spaces, to lymph, to venous system, to lesser circulation and again to lymph circulation as in the case of tracheo-bronchial node infection; or from tissue spaces by the same route to lesser circulation and then to greater circulation, as in the case of the spleen,—this must remain a matter of speculation.

At any rate, the time of infection of the lungs and spleen coincided with that noted by Oehlecker,—the fifth day; and that of the tracheo-

bronchial nodes antedated Oehlecker's first observation of it by six days. As has been already stated, infection was regularly noted in all the tissues from four days on, except that at five days the tracheo-bronchial nodes of the particular animal used were sterile. Oehlecker had a similar experience, in that while the spleens of the fifth and eleventh day after infection contained bacilli, that of the seventh day "missed" infection.

There are several cogent reasons that might be adduced in proof of the contention that, by the method described above, infection of an animal is initiated in a purely lymphogenous manner, and that, if bacilli in some way or other would happen to get directly into the blood stream (without the intervention of the lymphatic system), this must be a rare accident. But it is only necessary to call attention to one circumstance which appears decisive in this connection.

We had performed this identical method of inoculation many times before. In the early experiments Dr. Lange had made injections into new guinea pigs with tracheo-bronchial nodes removed six, twelve, eighteen and twenty-four hours, and then daily from two to six days after infection. The early removed tissues were all sterile: only after six days were tracheo-bronchial nodes encountered that contained bacilli. Oehlecker's experience was similar; his three day tissues were all sterile and infection appeared step by step at later intervals.

If bacilli had been introduced directly into the blood at the site and time of inoculation, or later, through the formation of delicate granulations, etc., and in this way had got to the lungs and other viscera, we would surely be able to detect them by the early inoculation of these organs. Yet it is just at this time when they are found to be absent in these locations.

b. As indicating the relative numbers of bacilli conveyed to the several organs and tissues. Early in the work we had indicated to us certain features of the spread of infection that were perhaps more important than the rate of dissemination of bacilli, the matter we had set out to investigate. They were certainly as enlightening and suggestive. The discovery was more or less fortuitous, and came about in the following way.

It had never been our habit to allow an animal to go unobserved from the time of injection with problematically tuberculous material to the time of autopsy. Beginning about two weeks after the injections and at regular intervals thereafter we had been accustomed to examine every

animal carefully and to note all evidences of the presence or absence of infection and its progress. As a result of this procedure in this experiment it soon appeared that infection was by no means developing alike in the several animals that had received the spleen or the lungs or the tracheo-bronchial nodes of the same tuberculous guinea pig. In some, palpable infection came to light earlier than in others, and developed more rapidly and to a greater degree, and as a rule kept in advance of the process in the latter. A specimen protocol will serve to bring out these differences more clearly.

Protocol. Guinea pig 2 was infected on December 23, 1918. Four days later (December 27) the bronchial nodes were injected (right groin) into normal guinea pig, 2A; the lungs into 2B; the spleen into 2C; and the iliac nodes into 2D (all as above described under *Technique*).

Twenty days later (January 16, 1919) animals 2A, 2B, 2C, and 2D were examined, and notes made of conditions at the site of injection.

The "readings" follow:

2A (tracheo-bronchial node animal). No reaction.
2B (lung animal). No reaction.
2C (spleen animal). Questionable reaction.
2D (iliac node animal). Marked and definite reaction.

At twenty-seven days (January 23) the notes are as follows:

2A. Definite reaction.
2B. Apparent reaction; slighter than 2A.
2C. Definite reaction.
2D. Marked reaction.

At thirty-four days (January 30):

2A. Marked reaction.
2B. Definite reaction; slighter than 2A.
2C. Very marked reaction; greater than 2A.
2D. Very marked reaction; greater than 2C.

At forty-seven days (February 12):

2A. Very marked.
2B. Marked; a little less than 2A.
2C. Very marked; about the same as 2A.
2D. Very marked; about the same as 2C.

At fifty-four days (February 19):
2A. Very marked on right side. Suspicious on left.
2B. Very marked on right side; here about same as 2A.
2C. Same as 2A.
2D. Same as 2A.

Ceteris paribus, the time of the first manifestation of lesion and the rapidity and vigor of its early development after subcutaneous infection are dependent on the numbers of tubercle bacilli originally introduced. Indeed, these criteria are, within certain limits, a better and more certain index of initial dosage than the extent of involvement of the body at a later period. If, now, one glances at the above protocol, one is at once struck by the circumstance that the tracheo-bronchial nodes produced lesion earlier than did the lungs and that for at least seven weeks the process due to injection of the lungs kept behind that set up by the nodes. This event was plain at our very first observations, and was rather astonishing for, if our current conceptions of pulmonary and tracheo-bronchial node relationships in tuberculous infection were sound, we had every reason to anticipate that both lungs would contain more bacilli than their regionary nodes, and that, therefore, the bacilli would evolve their effects first in the lungs.

A few observations on the activity of material from a single animal hardly constitute data for an inclusive generalization. But, as time elapsed, and our records became more complete, we found that what has just been described in animals 2A and 2B happened with hardly an exception in all other similarly treated animals of the experiment.

That the reader may appreciate the definiteness and regularity of this occurrence, and that he may also become familiar with the comparative infectiousness of all the injected materials, I have prepared table 2. The descriptions in the table are exact transcripts of our records, made at the times noted. The table shows the beginning and the character of the further development of the local infection, as this occurred after guinea pig inoculation of the several organs removed from other guinea pigs at varying intervals after infection of the latter.

Analysis of table 2. A general survey of the table at once discloses how it reflects the significance of dosage throughout. No matter what the injected material was, if it came from guinea pigs that had been infected only a few days before, by the third week palpable lesion is absent or is just getting under way. If, however, the original donor had been tu-

TABLE 2

Showing the local beginning and development of infection in the individual animals after receiving various tissues removed from guinea pigs at different intervals after infection of the latter

ANIMAL	INJECTED WITH FOLLOWING MATERIAL	INTERVAL BETWEEN INFECTION OF DONOR AND REMOVAL OF MATERIAL	CONDITION OF SITE OF INOCULATION OF ANIMALS INJECTED WITH TISSUES WITH THE TIME AFTER INJECTION NOTED				
			20 days	27 days	34 days	47 days	54 days
2A	Tracheo-bronchials	4 days	No reaction	Definite reaction	Marked reaction	Very marked	Very marked on right side: suspicious on left
2B	Lungs	4 days	No reaction	Apparent reaction: slighter than 2A	Definite: slighter than 2A	Marked: a little less than 2A	Very marked on right side: here about same as 2A
2C	Spleen	4 days	Questionable reaction	Definite reaction	Very marked reaction: greater than 2A	Very marked: greater than 2A	Same as 2A
2D	Iliac node	4 days	Marked and definite reaction	Marked reaction	Very marked reaction: greater than than 2C	Very marked: about the same as 2C	Same as 2A
			19 days	26 days	33 days	46 days	53 days
4A	Tracheo-bronchials	5 days	No reaction	No reaction	No reaction	No reaction	No reaction
4B	Lungs	5 days	Questionable	Definite	Probably definite	Definite to marked	Definite to marked
4C	Spleen	5 days	Apparently negative	Definite	Marked	Very marked	Very marked
4D	Iliac node	5 days	Apparently negative	No reaction	Slight, but probably definite	Marked	Marked

			18 days	25 days	32 days	45 days	52 days
6A	Tracheo-bronchials	6 days	Marked	Very marked	Enormous	Enormous	Enormous
6B	Lungs	6 days	No reaction	Slight, but definite reaction	Definite	Marked much less than 6A	Very marked less than 6A
6C	Spleen	6 days	Marked	Marked reaction on both sides	Marked, but less than 6A	Died at 37 days: death not due to tuberculosis	
6D	Iliac node	6 days	Enormous	Enormous	Enormous	Enormous	Enormous
			17 days	24 days	31 days	44 days	51 days
8A	Tracheo-bronchials	7 days	No reaction	Enormous on right side: definite on left	Very marked on both sides	Very marked on right: marked on left	Very marked on right: marked on left
8B	Lungs	7 days	No reaction	Apparently slight	Slight but definite	Marked	Marked: much less than 8A
8C	Spleen	7 days	Definite	Enormous	About same as 8A on right	Enormous	Same as 8A on right: marked on left
8D	Iliac node	7 days	Enormous	Enormous	Enormous	Enormous: about same as 8C	Enormous: discharging abscess
			16 days	23 days	30 days	43 days	50 days
10A	Tracheo-bronchials	8 days	Very marked	Enormous	Enormous	Enormous on right: definite on left	Excessive on right: marked on left
10B	Lungs	8 days	Questionable	Marked: less than 10A	Marked	Very marked: less than 10A	Very marked
10C	Spleen	8 days	Marked	Very marked; less than 10A: more than 10B	Very marked: less than 10A	Very marked: about same as 10B	Enormous: less than 10 A
10D	Iliac node	8 days	Enormous	Enormous	Enormous	Enormous: about same as 10A	Enormous: discharging abscess on right marked on left

TABLE 2—*Concluded*

ANIMAL	INJECTED WITH FOLLOWING MATERIAL	INTERVAL BETWEEN INFECTION OF DONOR AND REMOVAL OF MATERIAL	CONDITION OF SITE OF INOCULATION OF ANIMALS INJECTED WITH TISSUES WITH THE TIME AFTER INJECTION NOTED				
			15 days	22 days	29 days	42 days	49 days
12A	Tracheo-bronchials	9 days	Slight, but definite reaction	Marked	Died at 27 days: death not due to tuberculosis		
12B	Lungs	9 days	No reaction	Questionable	Marked	Very marked	Very marked
12C	Spleen	9 days	Very marked	Enormous	Very marked	Enormous	Enormous
12D	Iliac node	9 days	No reaction	Marked: about like 12A: much less than 12C	Definite, but less than the others	Definite	Marked: less than 12B
			6 days	13 days	20 days	33 days	40 days
16A	Tracheo-bronchials	18 days	Slightly enlarged and shotty right inguinal nodes	Enormous	Enormous	Enormous	Enormous on right: very marked on left
16B	Lungs	18 days	No reaction	Marked: much less than 16A	Very marked	Died at 31 days: death not due to tuberculosis	
16C	Spleen	18 days	Slightly enlarged and shotty right inguinal nodes	Marked: less than 16A	Very marked: about equal to 16B	Enormous: discharging abscess	Excessive on both right and left sides
			9 days	16 days	29 days	36 days	
18A	Tracheo-bronchials	22 days	Died three days after injection				
18B	Lungs	22 days	Slight reaction	Very marked	Enormous	Enormous: discharging abscess	
18C	Spleen	22 days	Questionable	Marked, but less than 18B	Enormous: discharging abscess	Very marked: discharging abscess	

			5 days	12 days	25 days	32 days	
22A	Tracheo-bronchials	26 days	Apparent definite reaction	Marked	Marked: animal died this day: death not due to tuberculosis		
22B	Lungs	26 days	Questionable	Questionable	Very marked	Very marked	

Note: In the above table there is a gap between 9 and 18 days. At 12 days four guinea pigs were injected as usual; but two of these soon developed an acute suppurative infection which obscured the tuberculosis, and this lot is therefore not tabulated. All of the animals, which are noted as having died, died of the interstitial pneumonia or obscure enteric disease which are so frequently observed among confined guinea pigs. All other animals came through without intercurrent disease.

Note: For analysis of tabulated data, see p. 165.

berculous for two weeks or longer, then material removed from it is producing appreciable effects as early as five, six or nine days after its injection; and by the end of the second week lesion is marked. Bacilli in four and five day material seem to be comparatively few or absent (4A). By six days they are more numerous in the animal under observation; and if one runs down the fourth week column one finds that reaction is uniformly much more marked at this time if the injected tissues came from a guinea pig that had been infected at least six days.

As a general thing, too, the iliac nodes set up the earliest and most marked infection (a single exception is 12D). This is what we should predict, for we would expect the iliacs, which are close to and practically in direct lymphatic connection with the portal of entry, to contain more bacilli than more remote organs early in the infection.

Infection due to the spleens keeps ahead of that set up by the lungs. In guinea pigs visible tubercle of the spleen ordinarily develops long before that of the lungs, and, at any stage of the disease, is commonly much more extensive in the former organ. The experiment shows that soon after infection there are more bacilli confined within the spleen than within both lungs. And, in this connection one should remember that all bacilli came to the spleen with the blood and that in their course to the spleen all passed through the capillaries of the lungs.

But it is the content of bacilli in the lungs, compared with that in the tracheo-bronchial nodes that should engage our most earnest attention. With a single exception (4A versus 4B) the experiment shows definitely that, *from as early as the fourth to as late as the twenty-sixth day after injection, there are at any time more tubercle bacilli in a guinea pig's tracheo-bronchial nodes than in its lungs.* As is the case in every other mammal, the blood supply to these nodes is by the bronchial artery (see Willis (8)). We cannot imagine that bacilli are to be found in such abundance in these nodes because they are carried there by the relatively insignificant branch of the bronchial artery that runs to the tracheo-bronchials. Other larger nodes in the guinea pig, as for instance, the submaxillaries, never exhibit tubercle unless they lymphatically drain a focus of tubercle or generalized infection is very advanced: yet they have their artery of supply,—as do the axillaries, the left iliacs, the left superficial inguinals, etc., and these two latter chains never exhibit tubercle until very late in a generalized infection. The path to tracheo-bronchials put forward by Weleminsky (22),—from superficial inguinals to iliacs to "lumbar" nodes, and thence by direct lymphatic afferents to tracheo-bronchials,—

as well as any other lymphatic path except those from heart and lungs, has been pretty thoroughly disposed of ((6) (7) and Beitzke (23)). The only way in which so many bacilli could have come to the tracheo-bronchial nodes is lymphatically from the lungs: and, since they must have entered the lungs by the blood, to get into the intrapulmonary lymphatics they must have first been temporarily fixed in the blood vessels and carried, through the walls of the latter, out into the tissue spaces[8] and lymphatics.

We are therefore led to the conclusion that for a time after pulmonary *infection* (infection, not lesion) is first established most bacilli are expelled from the lung (of the guinea pig) by the lymphatics. In other words, the guinea pig lung has an active and measurably competent capacity of "cleansing" itself,—a mechanism that must mean much to the animal's economy and may be no doubt modified by all factors which might affect the integrity of the intrapulmonary lymphatic circulation. Later in this study, and in a future study (on infection in the rabbit), we shall again take up details of this experiment to support a thesis we hope to establish concerning tuberculous infection of the lungs and their lymph nodes.

5. The evolution and spread of macroscopic changes from the point of inoculation. The experiment afforded a good opportunity to observe systematically gross changes as these unfolded themselves from day to day. We would not add a great deal to the numerous well-known descriptions of what might be termed the average macroscopic appearance of lesion after guinea pig infection. Nevertheless, it may be well to cite a few notes from our records, inasmuch as they point out possibilities as to the time of the first appearance of visible lesion after massive infection.

The site of inoculation of bacilli exhibits acute subcutaneous reaction up to the ninth day after infection.

Beginning at six days, distinct changes are to be noted in the superficial inguinal nodes: at this time the latter are "slightly enlarged and a little more opaque than normal;" at seven days, "enlarged and opaque;" at twelve days, "enlarged, opaque andwith yello wish spots" (necrosis); at eighteen days, there is an abscess of the soft tissues and "proceeding cephalicwards a chain of 5 to 7 enlarged nodes of which the one next to the abscess is largest and shows necrotic spots."

[8] Most of such bacilli probably do not get further than the adventitia of the vessels, in which lymphatics run. Tissue spaces exist, of course, in the walls of blood vessels, just as everywhere else.

At four days the right iliac node appears normal; at six days it is "somewhat enlarged, but pellucid;" at twelve days it is "enlarged and opaque;" while at eighteen days it is "as large as a bean and necrotic."

The first time that the spleen can be called tuberculous is at twelve days, when it shows 8 to 10 small, yellow tubercles; and at eighteen days and afterwards lesion is always well established.

The paraortic nodes were noticeably enlarged from twelve days on.

The lungs never exhibited gross tubercle,—up to twenty-six days.

The first time that the tracheo-bronchial nodes were unquestionably tuberculous was at twenty-two days, though before this there were suggestions of tubercle in these nodes. Until considerable enlargement occurs, early gross tuberculosis of the tracheo-bronchials is difficult to determine. The nodes are often completely involved without a trace of necrosis. When tuberculous they are usually whitish, have lost their pellucid appearance, and are firmer than usual,—often to stony hardness. Slight or early tracheo-bronchial node involvement is frequently overlooked by the untrained eye.

At eighteen days the retrosternal nodes (the nodes of the internal mammary artery) were "enlarged, firm and opaque." It will be remembered (see p. 141) that these nodes receive lymphatics from the tracheo-bronchials (as well as from the diaphragm and intercostal muscles). Their involvement is almost presumptive evidence that the tracheo-bronchials have been infected. Many authors have noted that in guinea pig infection they are among the first structures to exhibit changes such as enlargement and opacity.

6. The earliest microscopic evidences of infection in the right iliac and tracheo-bronchial nodes. We have as yet not finished our histological studies. These have thus far been centered on observations of the right iliac and the tracheo-bronchial nodes, although the other tissues have received incidental attention. We hope to present later the complete microscopic studies of the development of infection from the portal of entry to tracheo-bronchial nodes and spleen; but in this place I shall record only a few observations and discuss briefly their probable significance.

a. Changes in the right iliac nodes. It will be remembered that at four days the gross appearance of the right iliac node was normal, at six days it suggested involvement, and it was not definitely tuberculous before twelve days.

Bacilli were however present in sufficient number to be seen in occasional (that is, not serial) sections, and had brought about very minute tissue changes at a much earlier period than twelve days.

Figure 2 represents a field in a section of a right iliac node four days after infection of the right groin. It should be noted that there is a definite *aggregation* of bacilli at one spot, and that at this point the lymphoid cells have disappeared and there is a very tiny area of what is apparently necrosis.[9]

Figures 3 and 4 are drawings of fields in two different sections of the same iliac node six days after infection. In figure 3 we see a large clump of bacilli without any tissue change. In figure 4 bacilli are flourishing luxuriantly and in their neighborhood there has been a very evident loss of lymphoid cells. This field brings out on a small scale what we have noticed to be a uniform feature of the early reaction of lymph node tissues to tubercle bacilli. This feature is the entire absence of *tubercle* (using the term in its histo-anatomic sense).

Although we have examined scores of slides of recently infected lymph nodes we have never once seen lesion begin and proceed in the manner that is considered characteristic of tuberculous infection; that is, as a more or less orderly and layered aggregation (proliferation) of cells. Nothing comes to view early that suggests the nodular nature of tubercle. These *early* changes in lymph nodes have no proliferative features about them; nor have they any inflammatory features, for accumulations of leucocytes are lacking. In the uniformly dark blue background (uniform except for the lighter germinal centres) that is made up mainly of lymphoid cells, one first notices extremely minute and angular lighter areas that look like little holes in the section. If then one turns a lens of higher power to these points, it is here that tubercle bacilli are most likely to be found. The areas appear light because the lymphocytes have disappeared from them, or, as in figure 4, because these are apparently necrotic and have become mere shadows. The periphery of these areas is not darker than usual; as has been said, there are no features of exudation (inflammation). As time goes on these areas become larger and larger, when they may stain uniformly yellow and now disclose that they are apparently made up of large cells that look like epithelioid cells: yet these are not arranged concentrically and in globular fashion

[9] All tissues were fixed in Zenker's fluid, embedded in paraffin, and stained with carbol fuchsin, decolorized with weak acid alcohol (1 per cent hydrochloric acid in 95 per cent alcohol), and counterstained with haemotoxylin (Ehrlich's) and orange G.

as is the case in early tubercle in other tissues; and I have sometimes been of the opinion that they probably represent the normal reticulum cells of the node which have been made more prominent because the lymphocytes are no longer present. As time goes on these cells may lose their nuclei as they become necrotic in which event we are likely to see exudation for the first time, as the field becomes blackened with polymorphonuclear leucocytes and the necrotic tissue shows evidences of fragmentation.

At any rate, early lesion in these lymph nodes seems to develop differently than in other organs: it is characterized by astonishingly early necrosis, by a disappearance of lymphoid elements and by a thorough absence of nodular character.

Figures 2, 3, and 4 indicate that bacilli have been present in the nodes for some little time. In the four day node (fig. 2) there has already been a multiplication of bacilli with tissue change: single phagocytes could not carry so many bacilli and scatter them as shown in the illustration. Bacilli and lesion in this node were by no means numerous or marked: neither was found without prolonged and painstaking search. But at six days the quest was easier: the section from which figure 4 was drawn showed several areas like figure 4. Figure 3 probably represents an actively growing clump of bacilli which have focalized only very recently; for, though the clump is large, the bacilli have not become separated and have not spread as in figure 4, nor have they damaged the surrounding cells. In none of these particular fields did the bacilli appear to lie within the cells, although figure 3 conveys the impression that they are thus enclosed.[10]

It has been our experience to find that the first microscopic manifestations of infection of the iliac node are practically coincident with those of the superficial inguinals. Macroscopic lesion of the superficial inguinals, however, certainly precedes that of the iliacs: this circumstance is undoubtedly dependent on such factors as dosage. Nevertheless, all our observations have given us the impression that passage from the superficial inguinals to the iliacs is extraordinarily early and rapid, and that as soon as bacilli have reached the inguinals some pass through and proceed to the iliac of the same side.

[10] These drawings were made by picturing all the cells at *one* level (usually the level that brought out tissue changes best) and then figuring all the bacilli that were to be seen at the several levels of the field. The sections are from 7 to 10 micra thick, or several focussing planes of the oil immersion lens.

At eight days microscopic lesion of the iliacs was quite plain. It was then extending rapidly. At twelve days a considerable part of the cross section was involved.

b. Changes in the tracheo-bronchial nodes. The most extensive and prolonged studies have been made of sections of the tracheo-bronchial nodes. These have been gone over again and again in endeavors to detect bacilli and beginning lesion; but not the slightest sign of either has been discovered in any section of those nodes removed from four to nine days after infection.

In the twelve day node, however, both bacilli and lesion were found. These are depicted in figures 5 and 6, both of which are drawings of fields from the same section of a left tracheo-bronchial node twelve days after right groin infection.

In figure 5 the tissues are entirely normal except for one cell which is carrying a peculiarly arranged clump of tubercle bacilli. This is evidently a dead or dying cell. It stains deeply with the cytoplasmic stain (orange G) and its nucleus is more or less shrivelled, and withdrawn to one pole of the cell. There is no doubt in this case that the bacilli are intracellular. The whole picture gives one the impression that here is a cell of some kind (I shall not attempt to denominate it) which has picked up a tubercle bacillus somewhere and carried it into the node, the bacilli meanwhile multiplying and the cell being struck with disease and possibly death. We can easily imagine how, with the approaching decay of the cell, the bacilli will be set free and ready to exert their pathogenic effect on the surrounding tissues.

Figure 6 shows a pair of bacilli in a minute area from which the lymphocytes have disappeared and in which there is beginning necrosis.

The record of the gross appearance of the node from which this section was made is that the former was normal. The spleen of the same animal contained a few small tubercles, the paraortic nodes were enlarged and the right iliac enlarged and opaque.

At eighteen days the tracheo-bronchial nodes of animal 15 were normal to the naked eye. Nevertheless, the microscopic sections disclosed numerous small lesions, as evidenced by small light areas with loss of lymphoid tissue. It was in this same animal that the retrosternal nodes (those of the internal mammary artery) were first described as being enlarged and opaque.

Inoculation of tissue into animals is of course a vastly more delicate method of determining the presence of tubercle bacilli than is histo-

logical examination. To asseverate on the basis of microscopic observation that bacilli do not exist in a tissue or organ would be possible only after the most tedious and perhaps impracticable labor; for it would presume that the examiner had gone completely through serial sections of the entire tissue or organ in question. Therefore, while a positive histological report is decisive and may settle a disputed point, a negative one must always be accepted with some reservation. It is a task of the utmost difficulty to find bacilli in practically normal lymphoid tissue, when the bacilli are few; and the fact that several bacilli were seen in two different fields of the same section indicates that in this case, at least, they were present in no inconsiderable number if we view the tracheo-bronchial node as a whole. Yet it only was twelve days after right groin infection, and the gross appearance of the node was normal.

This finding may be contrasted with Oehlecker's (table 1). It will be remembered that by inoculation the latter was not able to demonstrate bacilli in the tracheo-bronchial nodes until eleven days after infection, while here is visible evidence of their presence twelve days afterwards.

7. Summary. By the method of tissue inoculation it has been shown that after subcutaneous (right groin) infection of guinea pigs with massive doses of tubercle bacilli, the bacilli are carried centralwards by the lymphatic stream and thence into the blood and throughout the body with great facility and rapidity.

At four days and earlier they have reached the iliac node of the inoculated side by way of the lymphatics.

At four days and perhaps earlier they are present in the spleen.

At four days they are also in the lung and tracheo-bronchial nodes. Most of those in the tracheo-bronchial nodes represent bacilli which have been carried out of the pulmonary blood vessels and thence over to intrapulmonary lymphatics by which they drained to the nodes.

It has also been demonstrated (table 2):

(1) That at any given time during the period of from four to nine days after infection there are more bacilli in the iliac node of the inoculated side than in the spleen or lungs or tracheo-bronchial nodes.

(2) That at any given time during this same period the bacillary contents of the spleen and tracheo-bronchial nodes are so nearly equal that animal inoculation of these tissues produces approximately the same effects.

(3) *That at any given time during the period from four to twenty-six days after infection there are more bacilli in the tracheo-bronchial nodes than in both lungs, which they drain.*

Gross changes have appeared as follows:

(1) The first definite lesion in the superficial inguinal nodes at six days and the first necrosis at twelve days.

(2) The first suggestions of lesion in the right iliac node at six days, and the first undoubted lesion at twelve days

(3) The first enlargement of the paraortic nodes at twelve days.

(4) The first undoubted changes in the spleen at twelve days.

(5) The first unquestionable lesion of the tracheo-bronchial nodes at twenty-two days.

(6) The first involvement of the retrosternal nodes at eighteen days.

(7) *During the twenty-six days of the first part of the experiment the lungs never exhibited lesion.*

The earliest microscopic changes appeared as follows:

(1) In the right iliac nodes there were both bacilli and lesion at four days, with evidences that both might conceivably occur earlier.

(2) The tracheo-bronchial nodes showed both lesion and bacilli for the first time at twelve days.

(3) The lungs, spleen and site of inoculation have not been described in this paper.

The architecture of beginning and early lesion in lymph nodes is peculiar in that it is not characteristic of classic anatomic tubercle.

THE OCCURRENCE OF TUBERCULOUS LESION IN THE LUNGS AND TRACHEO-BRONCHIAL NODES

With the above possibilities concerning the dissemination of tubercle bacilli understood, we may proceed to another phase of our inquiry.

The tuberculous guinea pig is remarkable in the distribution of *lesion* throughout its body. The extraordinary tendency of its spleen to exhibit tubercle has never failed to arouse comment, for it can be laid down that, among mammals in general, tuberculosis of the spleen is not a prominent character of the infection. In guinea pigs, on the contrary, the spleen is undoubtedly the organ that is most prone to tubercle. No satisfactory reason, that is, one with scientific support, has ever been advanced to explain this circumstance. The generalization has long been current that starting from a portal of entry tuberculous infection in the guinea pig is largely lymph-borne while in other animals as, for instance, the rabbit, it is for the most part blood-borne. I shall not pause to examine the validity of this opinion. But with it as a basis,

yet without laying down any intermediate chain of relationship, an effort has been made to bring the spleen in some way or other into intimate association with the lymphatic system, and thus account for splenic infection.

It should be hardly necessary to point out that tuberculosis arises in internal organs because bacilli have focalized there, and that bacilli have focalized there because first, they have been conveyed there from another point and second, because there was some local condition in the organ in question that favored their remaining there. Now, there is no lymphatic path efferent from any other part or organ of the body to the spleen. To get to it microörganisms must first pass into the blood, and so far therefore as receiving bacilli is concerned it stands in a preferred position only as regards the possibility that its artery carried to it more bacilli than other organs receive by their arteries. Such an explanation is thoroughly improbable.

There remains then the possibility that the internal anatomy and physiology of the guinea pig spleen differ from those of other animals,—a matter which must await consideration in a future study.

But there is another very remarkable peculiarity about guinea pig infection. This is, that in this animal which is by common agreement extraordinarily susceptible to tubercle and its generalization, *ceteris paribus* and compared to viscera like the spleen and liver, the lungs become tuberculous to an astonishingly slight extent. Indeed, if amount of lesion be a criterion of amount of infection we would say that the guinea pig lung is highly "resistant" to infection and that there exists some mechanism in its lungs that takes care of infection particularly well. For, as far as concerns the numbers of bacilli received, the lung must stand in a position that is at least equal to that of the spleen and liver: as a matter of fact, its position is vastly more favorable.

Here again, to account for what happens in the lung we must suppose that the pulmonary anatomy and physiology of the lung of the guinea pig are more or less peculiar to it: they certainly must differ from those of the rabbit.

At a later time, after I have related the peculiarities of pulmonary infection in the rabbit, I shall attempt to demonstrate that pulmonary lesion is intimately related to certain intravisceral anatomic (and therefore physiological) peculiarities. Such a discussion lies outside the scope of the present paper. In concluding this study and by way of preparation for later ones, I wish to direct attention to a third peculiarity

of guinea pig tuberculosis, which may be stated by the following proposition:

In the tuberculous guinea pig the presence and extent of lesion in the tracheo-bronchial nodes is not dependent on lesion in the lungs which they drain.

This is not to say that if lesion exists in the lungs its presence will not be reflected by the tracheo-bronchial nodes: so long as lymphatic paths are open, bacilli will "drain" from pulmonary lesion to these nodes and, if they remain, exert their effects here. It means that in the guinea pig the occurrence of pulmonary *lesion* is not a *sine qua non* of tracheo-bronchial tubercle; and that the latter frequently, indeed as a rule, is manifest although no tubercle may be evident in the lungs.

About a year ago (5) I touched upon this matter by describing the late disposition of lesion in guinea pigs that had been inoculated with tubercle bacilli of low virulence. This paper related that such infection was followed by evident changes in the tracheo-bronchial nodes without visible lesion ever occurring in the lungs and with only very occasional involvement of the spleen. In the experiment detailed above in the present study, I have also shown that at any time during the first three or four weeks after infection there were more bacilli in the nodes than in the lungs, a condition that compels the conclusion that for a time at least most of the bacilli that enter the tissues of the lungs are carried away to the regionary nodes. It now remains to demonstrate that after virulent inoculation tracheo-bronchial node tubercle occurs without pulmonary tubercle and to indicate, if possible, the factors that play their part in the production and further development of tracheo-bronchial node involvement.

Speaking of the guinea pig, Oehlecker (21) says, "Under normal conditions the tracheo-bronchial nodes are usually macroscopically visible but not always so;" and he describes these as being of the size of a grain of hemp or rice. Our own experience has been that in adult guinea pigs we have never failed to find these nodes: indeed, we have always looked upon them as being unusually prominent and as particularly well developed in young animals. We have never observed them as small as a grain of rice or hemp.

Figure 7 is an actual size drawing of the lungs and tracheo-bronchial nodes of an adult guinea pig that had been confined in the laboratory only a few days. It well shows a pair of nodes on either side of the trachea, overlying or immediately above the tracheo-bronchial angle, as

TABLE 3

Autopsy notes of 54 tuberculous guinea pigs that received primary inoculations and reinoculations of tubercle bacilli. To show the amount of lesion in the various organs of the individual animals (see p. 184)

ANIMAL	RIGHT SUPERFICIAL INGUINAL	LEFT SUPERFICIAL INGUINAL	RIGHT ILIAC	LEFT ILIAC	SPLEEN	LIVER	LUNGS	TRACHEO-BRONCHIAL NODES
1	++	+	+	++	Enlarged; half dozen cheesy points	Two or three yellowish points	No lesion	+
3	++	+	++	+	No lesion	No lesion	No lesion	Slightly enlarged
4	++++	+	++	+	No lesion	No lesion	No lesion	Practically normal
5	+	+	+	+	No lesion	One small yellowish nodule	No lesion	+
6	++	++	+	0	Several small cheesy points: not much enlarged	No lesion	No lesion	Markedly enlarged: firm; +++
7	++	+	+	+	No lesion	No lesion	No lesion	Enlarged: firm; +
8	+	+	+++	+	Enlarged: numerous cheesy points	No lesion	No lesion	Quite large and firm; ++
10	++	+	+	+	No lesion	No lesion	No lesion	Normal
12	++++	++	+++	0	Enlarged with about dozen cheesy nodules	Several cheesy points	No lesion	Enormous: very firm; ++++
13	+	+	+	++	No lesion	No lesion	No lesion	Slightly enlarged; ?
14	++	++	+	+	Enlarged with cheesy nodules	Several cheesy nodules	No lesion	Enlarged: firm; +
15	+	++	+	+	Very slightly enlarged: three or four cheesy nodules	No lesion	No lesion	Enlarged: firm; +
16	++	++	+	+	Not enlarged: several large cheesy nodules	No lesion	No lesion	Large and firm; ++
17	+	+	+	Slight	No lesion	No lesion	No lesion	Enlarged: firm; +

18	++++	++	No record	No record	Enlarged: numerous cheesy foci	Few yellowish points	No lesion	Markedly enlarged: firm; +++
19	+	+	Slight	Slight	No lesion	No lesion	No lesion	Practically normal
20	++	++	No record	No record	No lesion	No lesion	No lesion	Slightly enlarged: firm; +
21	+++	No record	+	No record	Enlarged with cheesy nodules	No lesion	No lesion	Large and firm; ++
22	+	+	+	+	No lesion	No lesion	No lesion	Slightly enlarged; ?
24	++	++	++	++	Enlarged but with no gross nodules	No lesion	Two small tubercles in left lower lobe	Moderately enlarged; firm; ++
25	+	+	+	+	Thoroughly nodular and cheesy	Cheesy points	No lesion	Markedly large and firm; +++
26	+++	+	+	+	No lesion	No lesion	No lesion	Markedly large and firm; +++
27	+	+	+	+	No lesion	No lesion	No lesion	Moderately enlarged; +
28	+++	+	+	+	No lesion	No lesion	No lesion	Slightly enlarged; ?
29	+	+	+	+	No lesion	No lesion	No lesion	Slightly enlarged; ?
31	++	0	+	0	No lesion	No lesion	No lesion	Slightly enlarged; ?
32	+	0	+	0	Normal size but with two or three cheesy nodules	No lesion	No lesion	Slightly enlarged: firm; +
33	++	0	++	0	No lesion	No lesion	No lesion	Practically normal
34	++	0	+	0	No lesion	No lesion	No lesion	Slightly enlarged, but pellucid; 0
35	++	0	+	0	Enlarged with many cheesy nodules	Several yellowish points	No lesion	Moderately enlarged: firm; ++
36	++	0	+++	0	Quite nodular	Markedly involved	Several small (1 to 2 mm.) foci	Markedly enlarged: firm; +++

TABLE 3—*Concluded*

ANIMAL	RIGHT SUPERFICIAL INGUINAL	LEFT SUPERFICIAL INGUINAL	RIGHT ILIAC	LEFT ILIAC	SPLEEN	LIVER	LUNGS	TRACHEO-BRONCHIAL NODES
37	++	0	++	0	Normal size with a solitary small cheesy nodule	No lesion	No lesion	Very slightly involved; +
38	+	0	+	0	No lesion	No lesion	No lesion	Enlarged and firm; +
39	+++	0	+	0	Normal size with two or three cheesy nodules	Several cheesy nodules	Several small sago-like foci	Moderately enlarged: firm; ++
40	+	0	+++	0	No lesion	No lesion	No lesion	Slightly enlarged, but pellucid; 0
41	+	0	+	0	Cheesy points with infarct at lower pole	No lesion	One fairly large tubercle in right lower lobe	Not enlarged; 0
42	+++	0	++	0	Large, with two or three cheesy nodules	No lesion	No lesion	Enlarged and firm; +
43	+	0	+	0	Very slightly enlarged with two cheesy nodules	No lesion	No lesion	Normal; 0
44	++	0	+	0	No lesion	No lesion	No lesion	Enlarged and firm; +
45	++	0	+++	0	Slightly enlarged, with cheesy nodule	No lesion	No lesion	Enlarged and firm; +
46	+	0	+	0	Slightly enlarged, with two small cheesy nodules	No lesion	One very minute sago-like tubercle in right upper lobe	Enlarged and firm; +

47	++	0	+	0	Slightly enlarged, with two or three foci	No lesion	No lesion	Very firm and hard; ++
48	++	0	++	0	Slightly enlarged, with half dozen cheesy nodules (2 mm.)	No lesion	No lesion	Large and firm; ++
49	+	0	+	0	Enlarged and very nodular	Markedly enlarged and cheesy	Several minute tubercles	+++
50	+	0	+	0	No lesion	No lesion	No lesion	Enlarged: firm; +
51	+++	0	No record	0	Normal size, several cheesy nodules	No lesion	No lesion	Moderately enlarged and firm: ++
52	+++	0	++	0	Markedly enlarged: numerous large cheesy nodules	Cheesy nodules	One small tubercle (2 mm.)	Very large, firm and nodular. ++++
53	+	0	+	0	Slightly enlarged with two or three cheesy nodules	No lesion	No lesion	Slightly enlarged; +
54	++	0	++	0	No lesion	No lesion	No lesion	Very slightly enlarged; ?
55	+++	0	++	0	Enormous: studded with tubercles	Advanced tuberculosis	Numerous small (1 to 2 mm.) foci	Very large and firm; +++
56	++	0	++	0	Enormous: very many cheesy tubercles	Yellowish points	Several cheesy foci	Very large and firm; +++
57	++	0	++	0	Markedly enlarged: advanced nodular involvement	Several cheesy points	No lesion	Very large and firm; +++
58	+++	0	+	0	Slightly enlarged: no nodules	No lesion	No lesion	Large and hard; ++
59	+++	0	+	0	No lesion	No lesion	No lesion	Slightly enlarged; ?

well as a single node (the *interbronchial* of Hashiba) closely applied underneath in the angle of division of the bronchi. It also faithfully reproduces the pellucid appearance of the normal node.

On January 7, 1920, we performed and recorded the autopsies of 54 tuberculous guinea pigs. All of these animals had been immunized on September 26, 1919, each with an inoculation into the right groin of 0.5 cc. of a heavy emulsion of the R1 culture of low virulence mentioned in my previous paper above cited (5). In addition to this, forty days later, on November 5, 1919, each animal received an intracutaneous inoculation of 0.1 cc. of a very dilute suspension of the virulent culture, H37, before mentioned. They were killed, therefore, just nine weeks after their virulent inoculation and almost fifteen weeks after their first infection with R1 bacilli.

The macroscopic lesions of every animal are listed in table 3. Reference to this will show that in general there is no correspondence between the condition of the lungs and that of the tracheo-bronchial nodes of the same animal. Animal after animal exhibited no involvement whatever of the lungs, yet its tracheo-bronchials were more than ordinarily tuberculous (2, 3 or 4 plus). But there is a very apparent relationship to be made out between the condition of the tracheo-bronchials and that of the liver and spleen, particularly the spleen. In almost every instance that we find the lung nodes unusually tuberculous, there is manifest invasion of the spleen. There are a few apparent exceptions to this rule,—animals 26, 38 and 44. In these the tracheo-bronchials are noted as being tuberculous, yet lesion is absent in spleen, liver and lungs. But we must remember that the initial R1 infection would in many cases localize in the lung nodes and there produce enlargement, opacity and a firmer consistence (5); so that, altogether apart from changes set up by the virulent inoculation, we must presume the existence of a basic R1 tracheo-bronchial involvement in a large number of the animals. The point is that when tracheo-bronchial involvement exceeds the amount that R1 might cause, such an animal's spleen or liver is always visibly affected; and since there are many animals with "clean" lungs, yet with much tubercle in the tracheo-bronchials, we may fairly conclude that it is tubercle in the spleen (or liver) that is providing the bacilli for the increment of the tubercle in the tracheo-bronchials. Animals 41 and 43 furnish the only exceptions of an opposite kind: in these there is visible tubercle in the spleen—in 41 even in the lungs—yet the tracheo-bronchials are noted as being normal.

This relationship between lesion in spleen and lesion in tracheo-bronchials was much more apparent at the autopsies than may appear from an inspection of the records. Indeed, it was so striking that by a glance at the spleen one could invariably predict without failure the condition to be encountered in the tracheo-bronchials.

To make this point stand out more sharply I have included table 4 and figure 8. Table 4 presents the autopsy notes of 9 guinea pigs, of which the conditions of infection were simpler. These were normal, non-immunized animals which were inoculated with virulent H37 tubercle bacilli exactly in the same way, with the same dosage and at the same time as the 54 guinea pigs of table 3. They were also killed on the same day, or nine weeks after a single infection.

These non-immunized animals show, of course, much more advanced tuberculosis; but in none are the lungs badly involved and in two (94 and 97) there is no visible pulmonary lesion. The reader should note the uniformly great involvement of the tracheo-bronchials, present even when there is no lesion of both lungs and liver (97), and manifestly running parallel with the condition of the spleen.

The situation is brought out very beautifully in figure 8. This is an actual size drawing of the lungs and tracheo-bronchial nodes of animal 88 listed in table 4, with lobes separated so as to show every tubercle in both lungs. It may profitably be compared with figure 7, the drawing of the normal lungs and their appendages.

In figure 8 we see lungs that have very little tubercle, yet with enormous node involvement at the root. There is a small tubercle at the caudal tip of the right upper lobe, one at the caudal end of the right lower lobe, and a bare half dozen minute tubercles in the lower half of the left lower lobe. The irregularly linear formation on the upper surface of the right lower lobe is not tubercle. It is a small patch of the interstitial pneumonia which is so common among caged guinea pigs, which has here become fibrosed, and which so far as we know does not lead to any impressive enlargement of the tracheo-bronchial nodes. While the lesions in the lungs will not explain the condition of the nodes, the tuberculosis in other parts of the body will. This animal's autopsy record reads, "Right superficial inguinal nodes extremely enlarged (++++) and caseous; right iliac nodes, extreme enlargement (++++) and caseous; left iliac node, enlarged and caseous; spleen, greatly enlarged and completely nodular; liver, numerous foci."

TABLE 4

Autopsy notes of 9 tuberculous guinea pigs, given a single inoculation of tubercle bacilli. To show the amount of lesion in the various organs of the individual animals (see p. 185)

ANIMAL	RIGHT SUPERFICIAL INGUINAL	RIGHT ILIAC	SPLEEN	LIVER	LUNGS	TRACHEO-BRONCHIAL NODES
88	++++	++++	Greatly enlarged and completely nodular	Numerous foci	Several small foci: not more than four or five in both lungs	Enormous; ++++
89	++++	++++	Moderately enlarged: several large cheesy nodules	No lesion	A very few pin head tubercles	Moderately enlarged; ++
90	+++	++++	Greatly enlarged and completely nodular	Numerous small cheesy areas	Only a very occasional tubercle, smaller than a pin head	Very hard; +++
91	++++	++	Enormous; very rough and nodular	Completely involved and caseous	Only very occasional pin point tubercle	Very large (2 cm.) and hard; ++++
93	++	+	Large and caseous	Markedly involved	Four or five small tubercles	Very large on one side with caseous points; ++++ +++
94	++++	++++	Moderately enlarged with large cheesy nodules	Cheesy nodules	No lesion	
95	++++	+++	Enormous; nodular and caseous	Several cheesy points	One or two very small tubercles	Quite enlarged; ++++
96	+++	++++	Moderately enlarged with cheesy nodules	No lesion	Several very fine tubercles	Very large and firm; ++++
97	++++	No record	Very large and cheesy	No lesion	No lesion	Enormous; caseous; ++++

These observations fortify the conclusion to which we have more than once been led in the course of this study; namely, that the guinea pig lung is a very "pervious" lung, in the sense that when it is functioning properly it allows an easy lymphatic passage of foreign particles through it; that it is so comparatively "resistant" to tubercle because of its anatomic constitution, by reason of which bacilli that reach its tissues are conveyed with great facility to its nodes; and that these nodes are peculiarly prone to tubercle because they are "open" to the larger number of bacilli that may get to the tissues of the lungs from *anywhere in the body* as well as bacilli that may be carried to them from lesion in the lung itself.

All the facts in the case enhance the truth of this opinion. The dust experiments of many workers point this way. So do the author's R1 experiments, already mentioned (5). So do the tissue injection experiments of an earlier part of this paper. So do the observations of other authors.

Oehlecker (21) noted that "macroscopically the tracheo-bronchial nodes become diseased coincidently or somewhat earlier than the lungs;" and in a very recent paper Rogers (24) mentions that seven days after guinea pigs had inhaled moist sprays of tuberculous sputum, macroscopic tubercle became visible in the lungs for the first time, when the tracheo-bronchial nodes "already showed distinct involvement."

Oehlecker also inclined to a similar opinion, which he supported as follows:

Microörganisms, which remain fast in the capillaries of the lungs and then wander into lung tissue, are evidently very rapidly moved to the tracheo-bronchial nodes by the lymphatics. Indeed, the first germs seem to be carried from the lungs to these nodes much more completely and regularly than bacteria sent by the haemotogenously infected spleen to the portal node; for the tracheo-bronchials are usually macroscopically diseased earlier than are the lungs, while the spleen and portal node become diseased at the same time. One may be justified in assuming that in young animals the lymphatics of the lungs are relatively very wide and pervious. . . . . When numerous bacilli wander out of the blood into the pulmonary tissue and when because of tracheo-bronchial node disease a stasis of lymph occurs in the pulmonary tissue, then a greater settling out of tubercle bacilli in the lung tissue seems to take place for the first time.

In the guinea pig, therefore, we would presume that in its several organs, tuberculous infection and lesion begin and proceed about as follows:

Microörganisms make the lymphatic journey from periphery to blood with facility and rapidity; and the time taken for the first bacteria to reach the veins will depend largely on the size of the infecting dose, for if this were very small the chances would all favor the at least temporary arrest of all bacteria before the entire lymph stream is traversed.

Once in the blood all bacilli pass at once to the lungs. At the first passage most make the entire circuit of the lesser circulation and go on to the general arterial tree. But some remain in the lungs where they are conveyed out through the vessel walls into the pulmonary tissues and lymphatics; and most of these are rapidly carried to the tracheo-bronchial nodes.

The bacilli that reach the systemic circulation are transported to all parts of the body, of which the internal anatomy of one organ is peculiarly adapted to their fixation. This organ is the spleen, in which disproportionately large numbers of bacilli remain permanently, and set up lesion. It is likely however that with every circuit of the systemic blood, most of the bacilli that come to even the spleen pass through the capillaries and proceed to the liver.

With this capacity for fixing bacilli and developing lesion the spleen becomes the great depot of tubercle and tubercle bacilli in the guinea pig body. As lesion and bacilli flourish, the latter are continually leaving the spleen by its lymphatics, if paths are unobstructed, and thus soon getting back again into the venous system; or, what is probably more common, they are continually being passed into the lumina of the blood vessels (the peculiarly intimate relations of the lymphoid Malpighian bodies to the blood vessels should be remembered here) and are thus being "fed" to the liver.

Anatomic conditions in the liver are not favorable for the focalization of small numbers of bacilli. In all probability the circulatory factors here resemble more those in the lung, and under normal conditions most bacilli which get out of the vascular system into the lymphatic system are easily conveyed to the liver (portal) node. For this reason the hepatic lymph node seems so dependent upon the spleen for infection that Oehlecker was convinced that bacilli drain directly by lymphatics from spleen to hepatic node. But, from an anatomic standpoint, such a transmission is an impossibility. It is probably nearer the truth that the liver "feeds" its node exactly like the lung supplies its node with bacilli,—that, as in the case of the latter organ, the liver is very

pervious to tubercle bacilli and passes them on to the hepatic node; and that, again like the lung, it exhibits lesion only slightly or comparatively late and only after it has received large and repeated dosage and its channels of drainage become impaired. The liver bears the first brunt of metastasis from the spleen, the most fertile provider of tubercle bacilli in the guinea pig. Just as the lungs are interposed as a "filter" between all peripheral lymphatics and the systemic circulation, so the liver acts as a "filter" for the lungs, standing as it does between the great splanchnic area and the lungs.

But it is also probable that with every circulatory round most bacilli go through the capillaries of the liver and return to the lungs, there to repeat the transit we have just described. With each successive circuit of the blood more and more bacilli become fixed in the several organs, until soon they disappear from the blood, to reappear at intervals as lesion develops and bacilli are intermittently mobilized from foci that have been established.

We thus have a situation in which the spleen early becomes the major centre of tubercle in the body, supplying both liver and lung with bacilli, which first manifest their most marked effects on the lymph nodes of their respective organs, and as these nodes become more and more involved and as metastasis from the spleen more and more frequent, accumulation of bacilli in liver and lungs with the production of lesion takes place.

Although the presumption of intravisceral anatomic determinants of infection has herein been based on collateral evidence, I hope in later studies to bring forward direct scientific proof of their actual existence.

Summary. In the tuberculous guinea pig gross lesion of the lung is not indispensable to the appearance of gross lesion in the tracheo-bronchial nodes.

Lesion in the latter very commonly exists without lesion in the lung. It is shown by experiment that the amount of involvement of the tracheo-bronchial nodes is directly related to the amount of tubercle that may be present anywhere in the body.

But it is also shown that since under ordinary conditions the spleen is the most extensive depot of tubercle in the guinea pig, the condition of the tracheo-bronchial nodes usually reflects that of the spleen.

REFERENCES

(1) MILLER, W. S.: Studies on tuberculous infection. II. A description of plastic models (reconstructions) of a conglomerate tubercle and the surrounding structures in a human lung. Amer. Rev. Tuberc., 1919, iii, 65.

(2) MILLER, W. S.: Studies on tuberculous infection. III. The lymphatics and lymph flow in the human lung. Ibid., 1919, iii, 193.

(3) MILLER, W. S.: Studies on tuberculous infection. IV. The vascular supply of the lymphoid tissue of the rabbit's lung. Ibid., 1919, iii, 449.

(4) KRAUSE, A. K., AND LANGE, L. B.: Notes on the experimental reinfection of guinea pigs with virulent tubercle bacilli. Natl. Tuberc. Assoc. Tr., 14th annual meeting, 1918, 365.

(5) KRAUSE, A. K.: Studies on tuberculous infection. I. A note on experimental tracheobronchial node tuberculosis together with a brief consideration of several phases of tuberculous infection suggested thereby. Amer. Rev. Tuberc., 1919, iii, 1.

(6) HASHIBA, G. K.: The lymphatic system of the guinea pig. Anat. Rec., 1917, xii, 331.

(7) MOST, A.: Untersuchungen über die Lymphbahnen an der oberen Thoraxapertur und am Brustkorb. Arch. f. Anat. u. Phys., Anat. Abt., 1908, 1.

(8) WILLIS, H. S.: Studies on tuberculous infection. V. The origin and relationships of the bronchial artery in the guinea pig. Amer. Rev. Tuberc., 1919, iii, 453.

(9) MILLER, W. S.: The distribution of lymphoid tissue in the lung. Anat. Rec., 1911, v, 99.

(10) PIERSOL, G. A.: Human anatomy, Fifth edition. J. B. Lippincott Company, Philadelphia and London.

(11) OETTINGER, W.: Die Disposition der Lunge zur Erkrankung an Tuberkulose. Zeitschr. f. Hyg., 1908, ix, 557; also in FLÜGGE, C.: Die Verbreitungsweise und Bekämpfung der Tuberkulose. Veit & Comp., Leipzig, 1908, p. 687.

(12) BORREL, A.: Tuberculose pulmonaire expérimentale. Ann. l'inst. Past., 1893, vii, 593.

(13) AUFRECHT, E.: Pathologie und Therapie der Lungenschwindsucht. Alfred Hölder, Wien, 1907, p. 138.

(15) SCHÄFER, E. A.: Text-book of microscopic anatomy. Longmans, Green & Co., London, 1912, p. 588.

(16) ARNOLD, J.: Über das Vorkommen lymphatischen Gewebes in den Lungen. Virch. Arch., 1880, lxxx, 315.

(17) OPPEL, A.: Lehrbuch der vergleichenden mikroscopischen Anatomie der Wirbeltiere. 1905, Bd. 6, Atmungsapparat.

(18) MAVROGORDATO, A.: Experiments on the effects of dust inhalations. J. Hyg., 1918, xvii, 439.

(19) TENDELOO, N. P.: Pathologische Anatomie, in BRAUER, SCHROEDER AND BLUMENFELD'S Handbuch der Tuberkulose. Johann Ambrosius Barth, Leipzig, 1914, vol. i, p. 84.

(20) ARLOING, S.: Leçons sur la tuberculose et certaines septicémies. Asselin et Houzeau, Paris, 1892. Dixième leçon: Généralisation et évolution de la tuberculose expérimentale, p. 109.

(21) OEHLECKER, F.: Über die Verbreitungswege der Tuberkulose im Tierexperiment mit besonderer Berücksichtigung des Weges nach den Bronchialdrüsen. Tuberkulose-Arbeiten a. d. kaiserl. Gesundheitsamte, Julius Sprenger, Berlin, 1907, H. 7, p. 65.

(22) WELEMINSKY, F.: Zur Pathogenese der Lungentuberkulose. II. Die Stellung der Bronchialdrüsen im Lymphsysteme. Berl. klin. Wchnschr., 1905, xvii, 743.

(23) Beitzke, H.: Über den Weg der Tuberkelbazillen von der Mund und Rachenhöhle zu den Lungen, mit besonderer Berücksichtigung der Verhältnisse beim Kinde. Virch. Arch., 1906, clxxxiv, 1.

(24) Rogers, J. B.: Further observations on the artificial tuberculous infection of guinea pigs through the respiratory route. Amer. Rev. Tuberc., 1920, iii, 750.

DESCRIPTION OF FIGURE 1, PLATE 1

THE DISPOSITION OF THE LYMPH NODES OF THE GROIN AND RETRO-ABDOMINAL REGIONS OF THE GUINEA PIG (See description in text, pp. 138 and 139)

This drawing has been made from a number of injected and non-injected normal specimens. The superficial inguinal lymph nodes, 5 in number, lie in the subcutaneous tissue of the reflected skin flap. These send several efferents, one of which courses to the deep inguinal nodes, two in number, which lie close to the abdominal ring, beneath Poupart's ligament, which is here cut away. Most efferents, however, go direct to the common iliac node, the large lenticular body which lies on either side, just above and in front of the bifurcation of the great abdominal vessels. Just below (caudal to) the common iliac node is a much smaller lenticular node, interpolated in the course of the efferents from the superficial inguinals. Hashiba denominates this the external iliac node and says that it is very inconstant. We have however found it quite regularly. The representation of the great plexus of lymphatics and nodes, immediately cephalic to the common iliacs, is more or less schematic. It is very variable in the guinea pig; and minute masses of lymphoid tissue, intercalated normally in this plexus, are undoubtedly very numerous: for, not infrequently under the influence of tuberculous infection, many come to view which are not normally visible. The larger nodes of this plexus, which are situated in the immediate neighborhood of the renal vessels, we have called the paraortic nodes in the text.

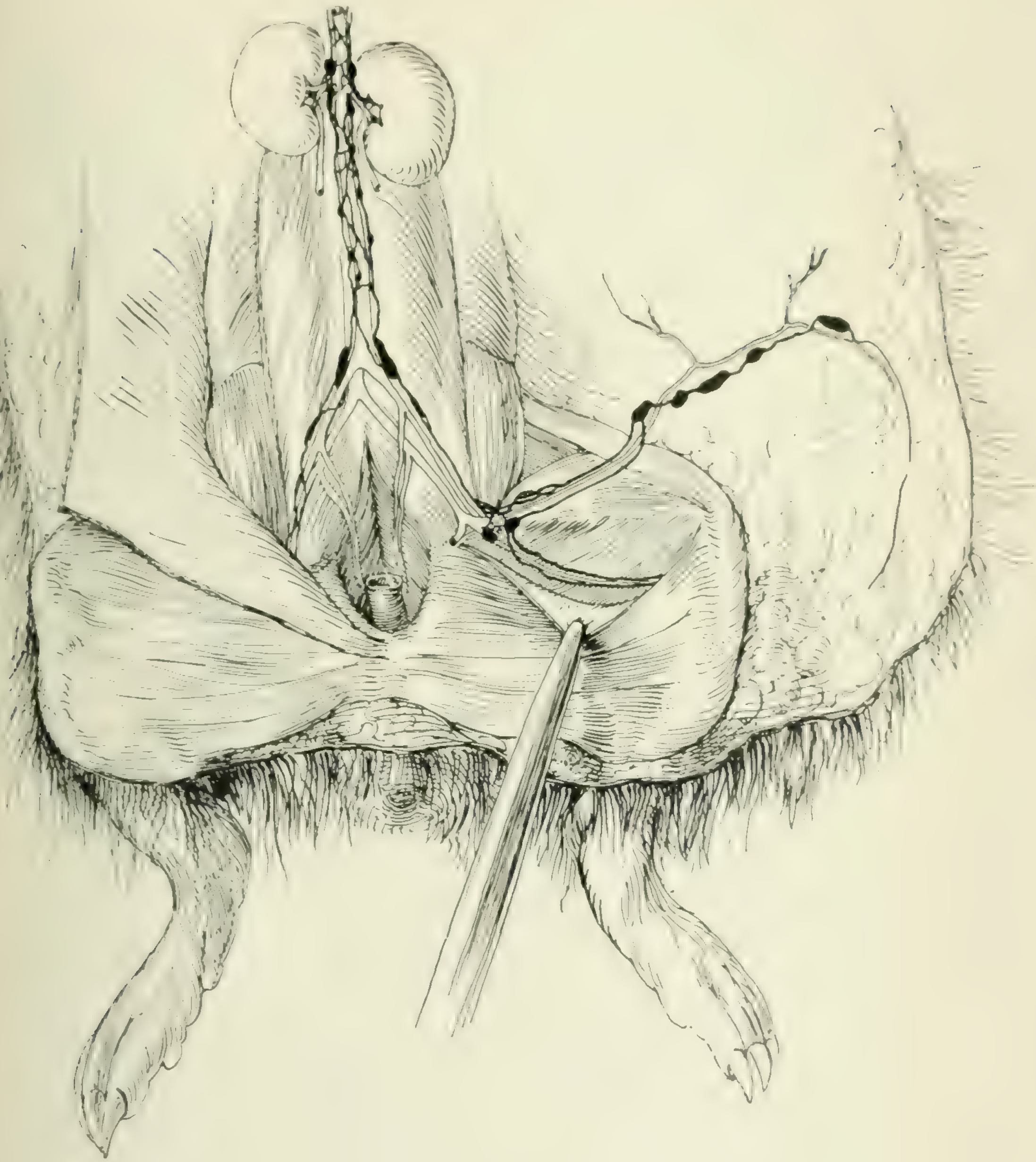

Fig. 1

EXPLANATION OF FIGURES, PLATE 2

Fig. 2. Common Iliac Node Four Days After Right Groin Infection × 1400
For description see p. 173 of the text

Fig. 3. Common Iliac Node Six Days After Right Groin Infection × 1400
For description see p. 173 of the text

Fig. 4. The Same Node as Figure 3 × 1400
For description see p. 173 of the text

Fig. 5. Tracheo-Bronchial Node Twelve Days After Right Groin Infection × 1400
For description see p. 175 of the text

Fig. 6. Tracheo-Bronchial Node Twelve Days After Right Groin Infection × 1400
For description see p. 175 of the text

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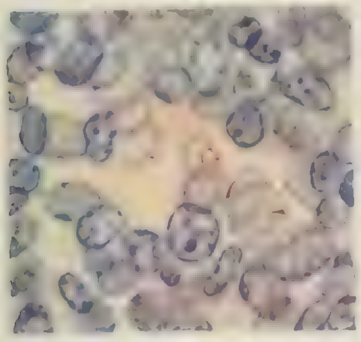

FIG. 2

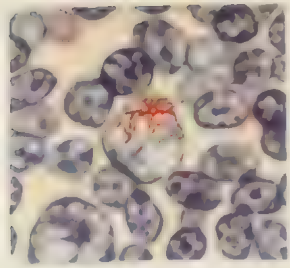

FIG. 3

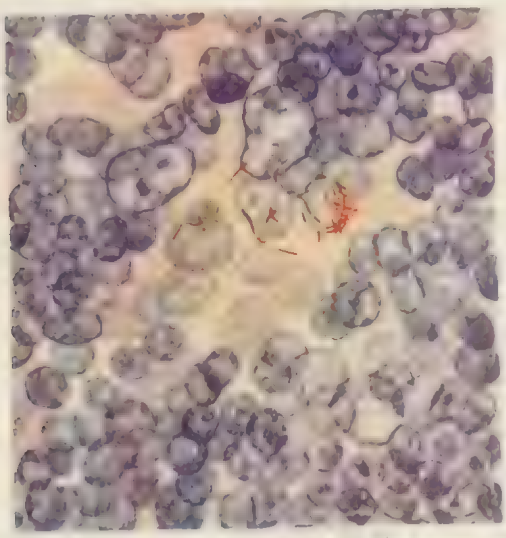

FIG. 4

FIG. 5

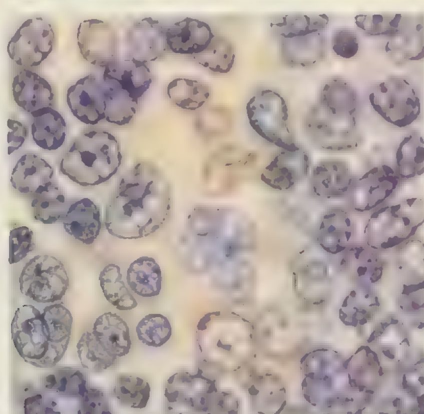

FIG. 6

DESCRIPTION OF FIGURES, PLATE 3

FIG. 7. LUNGS AND TRACHEO-BRONCHIAL NODES OF NORMAL GUINEA PIG (Natural Size)

FIG. 8. LUNGS AND TRACHEO-BRONCHIAL NODES OF TUBERCULOUS GUINEA PIG (Natural Size)

For description see p. 185 of the text

This animal with greatly involved tracheo-bronchial nodes had advanced tuberculosis of the spleen and numerous foci in the liver. The lobes of the lungs have been arranged so as to show all the visible intrapulmonary tubercle. This consists of a small nodule at the caudal tip of the right upper lobe, one smaller lesion near the caudal tip of the right lower lobe and a half-dozen minute nodules below the middle of the left lower lobe. The irregular linear area at the upper part of the right lower lobe is the nontuberculous interstitial pneumonia frequently found in confined guinea pigs.

FIG. 7

FIG. 8

STUDIES ON TUBERCULOUS INFECTION

VII. SOME FACTORS THAT INFLUENCE THE DEVELOPMENT OF TUBERCLE IN THE LYMPH NODES OF THE GUINEA PIG

ALLEN K. KRAUSE

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In a study on tuberculous infection in the guinea pig, immediately preceding this (1), attention was centered on those circumstances that determine involvement of the tracheo-bronchial lymph nodes of this animal and the factors that govern the degree and extent of lesion in these nodes. By becoming visibly tuberculous the latter will reflect the presence of manifest tubercle within the lungs, yet they exhibit a great amount of lesion when it may be impossible to detect gross intrapulmonary tubercle. Lesion in them need depend not so much on lesion in the lungs as upon infection elsewhere in the body; as for instance in the spleen which in the guinea pig may be looked upon as the depot of tubercle *par excellence*.

In the present communication it is the author's desire to point out briefly one or two features of infection of the lymph nodes in general which these investigations have disclosed and suggested.

It has become a commonplace that the *incidence*—the fact—of lymph node infection is dependent upon the condition of parts that are peripheral to a given node—parts which the node drains. This dictum is strictly true in the sense that there will practically never be any infection of a node unless there is also a focus (appreciable or otherwise) in its area of drainage. We have seen (1) how, when we come to consider central nodes like the tracheo-bronchials, we must regard their potential areas of drainage as confined not only to the lungs and heart but as including almost the whole of the body. Viewed in this light then, the maxim enunciated above holds good for the tracheo-bronchial nodes as well as any that may lie immediately beneath the surface of the body.

But even more important than the matter of the mere incidence of infection is that of the intra-nodal development of infection once bacilli have reached the node. In human beings lymph node *infection* must

be extraordinarily frequent: how else explain the enormous proportion of positive Pirquet tests? Yet it is the manifest and clinical disease, tuberculous lymphadenitis, that interests us as physicians. Why this lymphadenitis? Why this latter condition, which must represent an enlargement or an increment of all infection which had occurred some time anterior to its first manifestation?

There are two possible explanations and only two: namely, either that, for one or another of several reasons which will immediately occur to every reader, conditions are established within a node which favor the development and multiplication of bacilli after these have reached the node; or that there is an increment of bacilli in the node from a persistent focus of infection peripheral to it. In the first instance the issue would turn on the physiology of the node itself: we could assume, say, an initial infection which would or would not develop because the biological activities of the node were or were not favorable to the persistence of the infection within the node. In the second instance, the event would be governed by what we might conveniently term exogenous dosage of bacilli: as regards resistance, the node could be extremely competent, yet be at last overwhelmed by a succession of bacilli that were coming to it from a more superficial focus.

I shall not pretend in this study to hazard even a probable explanation of what actually occurs in the matter in question. I shall, however, attempt to formulate roughly what seem to be underlying factors of lymph node involvement—its progression or subsidence—in the tuberculous guinea pig.

I have long been struck by an apparent parallelism of the degree of lymph node involvement with the persistence, extent or intensity of a superficial focus of infection which the lymph node "drained." In general, it is true that lesion in a common iliac node corresponds with lesion in the superficial inguinal nodes from which the former receives lymph; just as lesion in the superficial inguinals, if charted, would follow the curve of virulence or dosage of the more superficial groin inoculation or the subcutaneous lesion (abscess, etc.) produced thereby. This will be brought out more sharply if we make our infections with a microörganism of comparatively low virulence. We may then note that, as the inguinal lesion progresses, the iliac node lesion tends to develop, while, as the former gradually becomes more and more sclerotic or gradually returns to normal, the latter subsides. We might of course explain this occurrence as being due to the fact that all of the various

nodes concerned resist the bacillus equally well, although such an explanation does not altogether suffice as an answer to why the condition of the more central node (the iliac) responds so delicately to that of the more peripheral superficial inguinal.

When we come to consider the relationship of lymph nodes to still more superficial lesion, such as that in the skin, the above explanation will not answer at all. I have made many hundreds of intracutaneous inoculations of living tubercle bacilli in guinea pigs, under many different conditions of dosage and virulence of microörganisms and of the immunity of the animals concerned; and, if the animals were carefully observed and compared, I have had the opportunity to note that with very few exceptions the state of the "draining" lymph nodes parallels that of the local skin lesion. In other words, the degree, extent and persistence of involvement of the nodes followed closely those of the skin infection.

If we make inoculations of living bacilli into the skin of the guinea pig's side about midway between the shoulder and the thigh, bacilli will proceed by lymphatics to both the superficial inguinal and the axillary nodes; and, if the skin lesion persists, involvement will occur later in both chains. It is almost invariable for a single gross lesion to appear in the skin; and then more bacilli are conveyed to the groin than to the axillary nodes; and involvement in the former chain is almost always much more pronounced than in the latter. Indeed, infection of the axillaries is hardly ever prominent unless inoculation is performed nearer the shoulder, although in an originally non-immune animal, while delayed, it becomes definitely palpable.

Recently, in one individual of a series of almost one hundred guinea pigs which had been given intracutaneous inoculations with living tubercle bacilli, there occurred a type of infection which I had never before observed. At the site of inoculation the lesion at first developed as usual, slowly and with the formation of a nodule which later broke down and ulcerated. The ulcer persisted. But there then came into view a number of tuberculous nodules in the skin, in the paths of lymphatic drainage, both cephalic and caudal to the original lesion. This was a most exceptional occurrence and resulted in placing new non-ulcerating intracutaneous tubercles in the domain of both the axillary and inguinal regions.

But the most significant circumstance was the subsequent development of enormous axillary bubo—a swelling of the axillary nodes such

as I had never seen before. In our large series there were animals with slowly healing lesions at the point of inoculation, as well as those with slowly progressing lesions with persistent open ulcers; but in no others was there an involvement of the axillary nodes which in extent even approached that noted in this particular animal.

This animal is pictured in figure 1, which well illustrates the features just noted. The drawing was made nine weeks after infection. The open, ulcerating, central lesion represents the site of inoculation which was a primary infection of a normal guinea pig. Both the inguinal and axillary buboes are excessive while the disseminated skin nodules stand out prominently.

In this case we must regard the extreme lymphadenitis as being due to an increment of infection from persistent foci peripheral to the affected lymph nodes. If new foci had not developed in the skin, if these had not been there to help "feed" bacilli to the axillary node, the latter would have exhibited only the same amount of involvement—a firm swelling about the size of a pea—as did all the other animals similarly infected and presenting at the same time merely single ulcerating lesions at the point of inoculation comparable to the one noted in this guinea pig.

To bring out this point more clearly I have prepared table 1 which follows. This table brings together data concerning the type of skin lesion as well as axillary node involvement in 10 guinea pigs, which were infected under exactly similar conditions as regards time and place of inoculation and emulsion and dosage of bacilli. Animal 90 of the table is the one represented in figure 1.

Remarks on table 1. As an intracutaneous lesion slowly progresses in a guinea pig which was a non-immune at the time of infection, small non-ulcerating nodules (tubercles) usually develop in its periphery. This uneven and nodular character of the rim surrounding the ulcer may be observed in figure 1. When reference is made to a "development of nodules" in the second column of table 1, it means these small nodules in the edge of the lesion. As has been stated above it is practically always the rule for a single localized lesion, confined to the site of inoculation, to follow intracutaneous infection. Almost invariably the next adjacent gross tubercle is to be found in the regionary lymph nodes.

With the exception of animals 88 and 90 the resulting skin lesions were reasonably uniform in character. In 88 the lesion was compara-

TABLE 1

Showing the character and extent of the local skin lesions and those of the axillary lymph nodes

ANIMAL	LOCAL LESION		AXILLARY NODES	
	General character and degree of local lesion throughout the experiment	Character of local lesion at time of death (autopsy)	Time of first palpable changes Days after inoculation	Maximum degree of involvement
88	Not marked	Healed	56	+
89	Indolent development of nodules	Ulcer nodular scabbed	35	++
90	Wide spread development of nodules	Large ulcer widely disseminated nodules	21	++++
91	Slow and local development of nodules	Large ulcer nodular	35	+
92	Slow development of nodules	Large ulcer nodular	42	+
93	Slow development of nodules	Large ulcer nodular	21	+
94	Slow development of nodules	Deep ulcer nodular	21	++
95	Slow development of nodules	Deep ulcer nodular	21	++
96	Slow development of nodules	Deep ulcer nodular	21	++
97	Slow development of nodules	Deep ulcer nodular	29	++

tively slight: in 90, extraordinarily severe. We find therefore that axillary involvement in 88 was greatly delayed and was not definitely palpable until fifty-six days after injection. Again, the local skin lesion was more of the retrogressing type and in fact went on to apparent healing. These several facts indicate that for some reason or other the skin at the site of infection in this guinea pig reacted so well to the bacilli that there was at no time the customary multiplication of bacilli in situ that accompanies a persisting non-healing and progressive skin lesion. For this reason, therefore, relatively few bacilli were conveyed to axillary node and the latter's involvement was correspondingly slight and delayed.

That the slight local and regionary node tubercle in animal 88 was not due to an inherent resistance of the skin and axillary node was well brought out by the general autopsy of the animal. This disclosed advanced tuberculosis of the spleen, moderate tuberculosis of the liver and slight tuberculosis of the lungs, a result which was well in accord with visceral changes that took place in all the other guinea pigs of the series. I am inclined to believe that in this particular instance the inoculation was made unusually deep into the skin so that not all of the injected bacilli were confined within the layers of the skin and that some of them at once penetrated the loose subcutaneous areolar tissue whence dissemination by lymphatics is more rapid and easier than from the skin itself.

Viewed as a whole, the table indicates that the more severe the local infection the greater the amount of tubercle in the regionary nodes. Differences of local lesion are not so sharp that we can speak in exact terms, but in animals 94 to 97 in which the ulcers are noted as deep there occurred a relatively early appearance of definite changes in the axillary nodes and these changes progressed to the point of moderate involvement. Animal 90 has been discussed above in sufficient detail.

We may say that in the guinea pig the lymph nodes, once infected, take care of the infection well. If there is not a more or less constant "feeding" of bacilli to them from more peripheral depots of infection, the tuberculous process tends to become arrested in them. Such, at any rate, would be my net impression that has slowly crystallized out of a number of years' observation. And correlative with this view is the belief that progressive infection of lymph nodes in this animal is, *up to a certain point*, largely (if not wholly) contingent on unhealed or unarrested infection at points peripheral to the nodes: it is the end

result of repetitions and accumulations of infection from places outside the nodes themselves.

If this were true and if the same state of affairs obtained after human infection, the importance of its recognition in clinical medicine is obvious. We would at once wonder whether in general the clinical outbreak of tuberculous cervical lymphadenitis in human beings were not largely determined by repeated infections from more peripheral and concealed foci, as for instance, in tonsils or in adenoid growths in the naso-pharynx. That such unrecognized foci are frequently present in these locations can no longer be doubted. Clinical (that is manifest) tuberculosis of the tonsils or of naso-pharyngeal adenoid growths are extraordinarily rare, yet more than one author, using comparatively rough methods of detection, has found a tuberculous *infection* incidence of 5 per cent in tonsils and adenoids removed, not for tuberculosis, but because of other pathological conditions. We must presume therefore that the actual incidence of tonsillar and adenoid tuberculous infection is considerably in excess of five per cent in the type of patients represented in reported studies. If, too, there is this much tonsillar and adenoid infection, it follows with certainty that bacilli are being continually conveyed from many of these superficial foci to deeper cervical lymph nodes, and thence to a lesser extent throughout the body. It follows also that good surgical procedure would require that the removal of tonsils and adenoids accompany the enucleation of tuberculous cervical nodes, whenever this latter operation is performed—a procedure that not a few surgeons have empirically found to yield more satisfactory results than the extirpation of the offending neck nodes alone. I am far from pushing this point or advocating it: I am merely suggesting that what in the practice of some has proved to be good surgery may have some scientific basis of fact.

The reader must not get the idea that when, in the above paragraphs, we have spoken of superficial or peripheral lesion we mean of necessity a lesion on the surface or a visible ulcerating lesion. Tuberculous lesion does not originate *on* epithelial surfaces. It arises beneath the surface where it may grow and form a nodule which may extend to and above the surface and through which it may break and ulcerate. Lesion may be at any point in the area of lymphatic drainage between the surface and the affected node. It may or may not ulcerate. It may be large or minute. The point is that *up to a certain point* the intra-nodal lesion will not become progressive unless the more peripheral lesion persists and continues at intervals to send bacilli to the node.

SUMMARY

In the guinea pig the existence of tubercle in a lymph node is contingent on the occurrence of lesion at a point peripheral to the node.

The progression or retrogression of tubercle in this animal's lymph nodes is largely dependent on the progression or retrogression of the peripheral foci.

REFERENCE

(1) Krause, A. K.: Studies on tuberculous infection VI. Tuberculosis in the guinea pig after subcutaneous infection, with particular reference to the tracheo-bronchial nodes. Amer. Rev. Tuberc., 1920, iv, 135.

FIG. 1. FOR DESCRIPTION SEE PAGE 196

VINCENT'S SPIROCHAETE AND HAEMORRHAGE IN PULMONARY TUBERCULOSIS

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The purpose of this communication is to present for consideration the rôle played by Vincent's spirochaete (or Bacillus fusiformis) in hemorrhage in tuberculosis pulmonalis.

We who practice medicine in the tropics, and particularly among Filipinos, occasionally come across cases of more or less severe haemoptysis, in which the blood has a laked appearance. Such attacks are intermittent in character, occasionally with intervals of months between them.

These patients present no evidence in their history or general symptoms, or on physical or radiographic examination, of pulmonary tuberculosis, nor can the Paragonimus Westermani be demonstrated in their sputum, which, on the other hand, is teeming with spirochaetes and the B. fusiformis.

My attention was first directed to this microörganism as a possible cause of hemorrhage in tuberculosis by their large numbers in the sputum of a patient in Leahi Home, who had had a previous frank haemoptysis of laked blood. My interest was further aroused when, on examining the radiographic plates of this case, a rounded, definitely limited shadow, about the size of a small orange, was noted just to the right of and slightly below the level of the hilum, and upon also finding in the radiographs of another case a similar characteristic shadow in the same situation.

On consulting the records this second case was also found to be complicated with hemorrhage, and the spirochaete and B. fusiformis were present in the sputum in large numbers.

An examination of other radiographs resulted in thirteen being found with this same characteristic shadow. All were cases complicated with hemorrhage and all had the spirochaete and B. fusiformis in large numbers in the sputa. Since then eight other cases have been observed with this shadow—all of which had hemorrhage as well as these microorganisms in the sputa.

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To rule out syphilitic infection and a probable gumma, I made Wassermann tests on all these cases. All were negative but one, which gave a one plus reaction. As this case became arrested without syphilitic treatment, this reaction was undoubtedly one of those occasionally found in tuberculosis pulmonalis.

These shadows are illustrated in figure 1.

Further suggestive, though admittedly not conclusive, evidence that this shadow has some relationship to hemorrhage and the spirochaete is offered by figures 2 and 3.

FIG. 1a

FIG. 1b

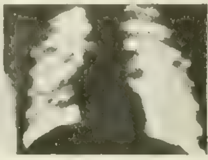

FIG. 2a

FIG. 2b

FIG. 3a

FIG. 3b

Figure 2 a is the radiograph of a case on admission. The shadow is distinct and hemorrhage was a complication, the spirochaete being present in the sputum in large numbers. Figure 2 b is the same case six months later: the shadow has almost disappeared, there had been no hemorrhage for several months and the spirochaete was no longer present in the sputum.

Figure 3 a is a case that had hemorrhage and spirochaetes in the sputum on admission. Figure 3 b is the same case eight months later: the shadow is persistent, hemorrhages were still recurrent, and the spirochaete was still present in the sputum.

Why the spirochaete (if it is the cause of this shadow) chooses this locality so frequently for its effect may be on account of the straight path offered to it by the right bronchus, as against the angular one of the left bronchus.

I realize that an assumption that this shadow is caused by a lesion due to the spirochaete of Vincent, based upon the limited evidence submitted, is unwarranted; but I present the facts in the hope of arousing the interest of more capable investigators.

The sputa of 410 cases of tuberculosis pulmonalis have been examined for the presence of the bacillus fusiformis and the spirochaete. Such sputa when cultured in broth, under albolene, presented a great number of the dual forms in seventy-two to ninety-six hours.

Isolation and further identification could not be carried out, as I was called upon to take charge of the Territorial Board of Health Laboratory and no other bacteriologist was available.

This partial investigation has resulted in some very suggestive findings, worthy of a preliminary report:

Of the 410 cases of sputum examination, 256 showed the presence of the spirochaete, while in 154 it could not be found.

Of the 256 positive cases, 182 were cases complicated with hemorrhage or 71 per cent.

Of the 154 negative cases, 56 were cases complicated with hemorrhage, or 36 per cent.

The corollary of this shows that of 238 cases with hemorrhage, the spirochaete was present in 182, or 76 per cent, and of the 172 cases without hemorrhage the spirochaete was present in 74 or 43 per cent.

Examining the records more closely, still further suggestive evidence is found.

One is perfectly satisfied to accept the presence of cavitation, or even ulceration of a congested mucous membrane as a cause of haemoptysis, but on the other hand it is frequently surprising, in certain cases, why hemorrhage, of no small amount, should occur in a lung presenting such few pathological signs on physical and radiographic examination. And *vice-versa* it is equally puzzling why, in a large number of cases with diffuse cavitation, no haemoptysis, worthy of the name, occurs.

Now if the series of cases under consideration is divided into those cases in which cavitation can be ruled out (incipent cases), and those cases in which there is a probable or evident active cavitation (advanced cases), there will be 205 incipient and 205 advanced cases.

Of the 205 incipient cases 118 had hemorrhage, and in all but 13 was the spirochaete demonstrable. Also of the 56 cases in which the spirochaete could not be found, there was active cavitation in 43.

We are therefore warranted in drawing the following conclusions. In cases of tuberculosis pulmonalis:

1. The presence of the spirochaete of Vincent (and B. fusiformis) in the sputum makes hemorrhage a probable complication (76 per cent). The absence of the spirochaete is against hemorrhage (36 per cent).

2. Hemorrhage rarely occurs in incipient cases unless the spirochaete is present (be the spirochaete the cause of the hemorrhage or merely an indication of mixed infection, or other predisposing factors.)

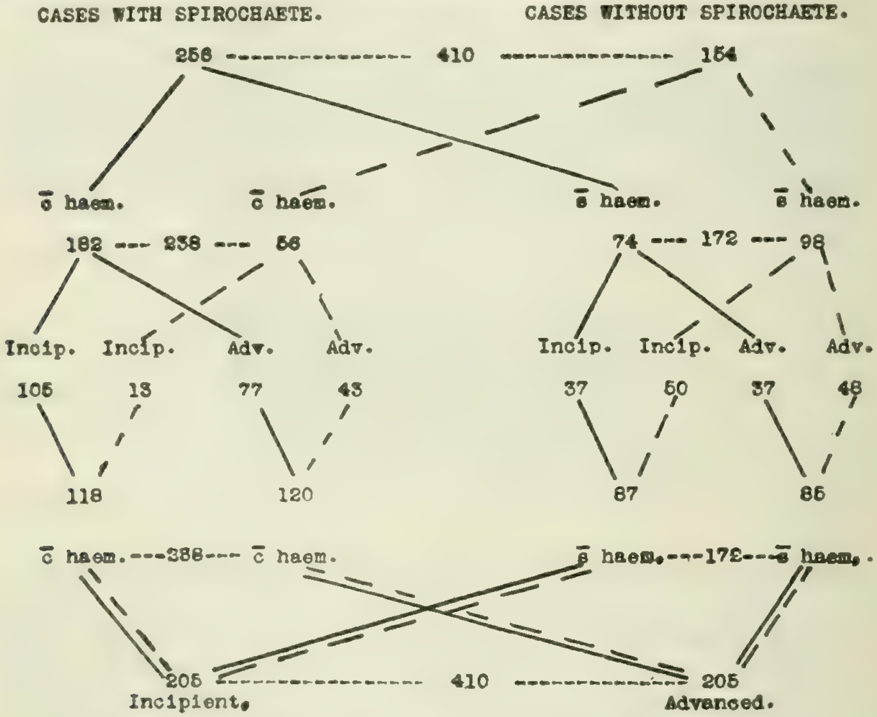

Chart 1. Showing Relations to Haemorrhage and Stage of Disease

3. An examination of the sputum in all cases, and particularly in incipient cases, for the presence of the spirochaete, should be of great value when desiring to determine the amount of exercise (or other hemorrhage favoring factor) the patient may indulge in. When present the patient should be treated as one in whom hemorrhage has already occurred: when absent considerably more latitude in exercise and general freedom may be allowed.

GOVERNMENTAL HOSPITAL FACILITIES FOR DISCHARGED TUBERCULOUS SOLDIERS

On February 3, 4 and 5, 1920, hearings were held in Washington before the Committee on Public Buildings and Grounds, House of Representatives, on additional hospital facilities for discharged soldiers, sailors, marines, and army and navy nurses (H. Doc. No. 481). The following extracts which relate to tuberculosis are taken from Document No. 14 of the Committee.

February 4, 1920

STATEMENT BY DR. EDWARD R. BALDWIN

Dr. BALDWIN. The question was whether in tuberculosis cases the best or most advanced medical thought of this day leans to the idea that there should be almost complete rest in the treatment, both mental and physical. The answer which I would be privileged to give you, as I have been introduced as a professional tuberculosis man, is that it is true; but that answer has qualifications that both rest and exercise might be considered equally important. Rest during the active stage of the disease and mental and physical exercise as soon as the disease becomes quiescent would be, in brief, my answer to that. . . . .

Mr. CLARK. I would like to ask you one question. At what particular stage of the disease would you advocate mental and physical exercise?

Dr. BALDWIN. At many stages.

Mr. CLARK. How is that?

Dr. BALDWIN. At practically all of the stages except for the man who is bedridden, of course.

Mr. CLARK. Isn't it the practice to put them all to bed when they first come for treatment and keep them in bed for quite a long while?

Dr. BALDWIN. Not any length of time; no, sir.

Mr. CLARK. What would you say would be about the average?

Dr. BALDWIN. The average is about one month of complete rest for incipient cases; possibly three months for moderately advanced cases; and six months for more or less chronic or far advanced cases,

if you understand these terms. They are more or less technical. The term "far advanced" may apply to a man who is doing a fairly good day's work. That should be understood.

Mr. CLARK. I think we understand, but I did not know about the work.

Dr. BALDWIN. It has been found that a certain amount of work which is interesting and satisfying to a patient is quite consistent with very good progress in the arrest of the disease.

Mr. SMITH. I am interested in the kind of buildings that we should erect. Would it be necessary in the treatment of tuberculosis, for instance, to have expensive buildings?

Dr. BALDWIN. If it is intended for a permanent structure I think it should be a building that is built with considerable regard for the future, and should be durable, not necessarily of expensive construction. I should say that it should have plenty of light and ventilation.

Mr. SMITH. That is what I thought, that is what I had in view that the main object was plenty of good light and ventilation.

Dr. BALDWIN. Yes, sir.

Mr. ELLIOTT. I just want to ask the doctor if he thinks it is necessary to build these tuberculosis hospitals in as expensive a manner as Trudeau Sanatorium has been constructed, these buildings?

Dr. BALDWIN. I would answer, sir, that Trudeau Sanatorium would be no criterion whatever for any other. A good many of those cottages have been given by different individuals as monuments to their friends.

Mr. SMITH. Would you recommend that these hospitals should be built in the country?

Dr. BALDWIN. I would select a place where the air was salubrious, with large grounds, on a hill side within the limits of a city, or within a short distance of a trolley line not too far distant from a city. That would be the situation I should recommend.

Mr. SMITH. These patients should be in the West and in the Southwest, should they not? There would be a big advantage in location and a saving in the kind of buildings that it would be necessary to construct.

Dr. BALDWIN. My personal opinion about that would be influenced a good deal by the number of men near the location of the hospital, or the nearness of their homes. I believe as a general policy the treatment of tuberculosis on a large scale in this country or in any other

country, particularly with men who have families, that it should be possible to treat them more successfully, much more successfully, within a reasonable distance of their homes.

Mr. CLARK. What do you think about the climatic conditions?

Dr. BALDWIN. In the first place, I think that there is an exaggeration in regard to the climatic treatment that has been traditional in the medical profession and in the lay mind. Good results can be obtained, I think equal results, in a great many different climates, whether sunshiny, or dark, or cold, or wet, or hot. As a rule the patient is better satisfied in the long run if he is near his family and has attractive surroundings with good food and diversion of some kind.

Mr. CLARK. In other words, keep his mind occupied?

Dr. BALDWIN. The mental condition has a lot to do with it.

Mr. CLARK. So it is necessary, Doctor—isn't the ideal treatment a treatment that will give as near perfect rest to the mind and to the body as possible?

Dr. BALDWIN. So long as treatment is required; yes, sir.

Mr. CLARK. Now then, Doctor, I want to ask you one more question. Has climate got anything to do with it?

Dr. BALDWIN. Yes, sir.

Mr. CLARK. Sir?

Dr. BALDWIN. Yes, sir.

Mr. CLARK. If that is correct, then you cannot have all these patients near their homes.

Dr. BALDWIN. Well, sir, I would like to qualify the blank statement that climate has much to do with it. Climate has something to do with it. In other words, take a day like this (cold, dark and sleeting) it is not agreeable for a patient to sit outside and take the open air, not as agreeable as it would be if the sun was shining clear and the air was dry, but the difference is largely psychic. But, where we are building a hospital in a climate similar to this, we could protect the patients from exposure. Those things can be obviated in treatment. Consequently the elements of the climate which go to make up the favorable environment of the patient are not all outside of our control you see.

Mr. CLARK. Now, there is just one other question I would like to ask you. Do you hold the position that a patient that has contracted tuberculosis can recover more surely and more speedily if transferred to a different climate than that in which he contracted the disease or can he recover more surely and more speedily in the same climate?

Dr. Baldwin. If I should answer that question without qualification, I should say that he could recover equally well anywhere, provided he has the essentials.

Mr. Clark. Has the same treatment?

Dr. Baldwin. The essentials.

Mr. Smith. Your theory is that a person should be treated as near to his own home as possible. Would it not be best except in chronic cases to treat the man in his own house?

Dr. Baldwin. That would seem to follow but it has not been found in practice to work out.

Mr. Smith. Why?

Dr. Baldwin. In the first place, it is important that he be not surrounded by his friends, in the same house, and there is very great difficulty in treating a person in his home because he may have children.

Mr. Smith. Not many of these boys. This is not provided especially for married people. These boys are largely young men that are needing treatment. They are not married, possibly not more than one in 50 is married.

The Chairman. Isn't it impossible to give the right kind of treatment in a person's home——

Mr. Chindblom (interposing). Isn't there danger of infecting people around them?

Dr. Baldwin. As a matter of fact the men are not very welcome in their surroundings. With the present attitude of people he is very apt to be made a leper. . . . .

Mr. Chindblom. I do not know whether this has been brought out or not. Isn't it a fact that it is better for a man to be treated in the atmosphere and in the climate in which he expects to live?

Dr. Baldwin. There is something in that. I believe I have answered a similar question that was asked by some other gentleman. The fact remains that tuberculosis can be treated successfully in any climate. There are certain ways of accomplishing this. In the same climate, for instance, let us suppose that we are in the South where the climate the year round is debilitating. Then an invigorating climate is rather essential. But, if a man is going to live in the city of Mobile, for example, or New Orleans, if he is going to look forward to living there, I believe in many instances a cure could be made and should be made as near that place as possible. If the man suffering from tuberculosis

should go to a climate having a high altitude, with very cold dry air, then obviously when he goes back to New Orleans or Mobile it would possibly react badly upon him. Does that answer your question?

Mr. ANDREWS. Doctor, as I understand a patient suffering from tuberculosis can be treated and good results can be secured in treating a tuberculous patient anywhere in the United States so far as climate is concerned.

Dr. BALDWIN. Practically; yes, sir.

Mr. ANDREWS. Now what you really regard as the best location is on a hill——

Dr. BALDWIN. Elevated country places, surrounded by good air—that is, where there is no smoke and dust.

Mr. ELLIOTT. Are you familiar with the United States marine hospital at Fort Stanton?

Dr. BALDWIN. Only through knowing Maj. Smith and his service, and his work.

Mr. ELLIOTT. Well, that institution, or was, when I saw it 14 years ago, is built about as cheaply as it is possible to build an institution of this kind. Do you know what results are being obtained there as compared with the results being obtained at Trudeau?

Dr. STIMPSON. Dr. Smith could answer that.

Dr. SMITH. It is impossible to make comparison, because at Trudeau they have a different class of patients from the patients that we have at Fort Stanton; but I think Dr. Baldwin will bear me out that the statistics of all institutions, no matter where located, show practically the same number of apparent cures for patients in the same stage of the disease. For instance, the percentage of apparent cures of moderately advanced cases is practically the same at Trudeau as the apparent cures of moderately advanced cases in New Mexico.

Mr. ELLIOTT. In 1905 I was appointed a member of the Indiana board, and I visited Fort Stanton, N. Mex., that year, and the next year we visited Trudeau. I mention these two institutions because one seemed to be an extreme in one direction and the other in the other. At Fort Stanton, as I remember at that time, their buildings accommodated or were arranged to accommodate two men at a cost of about $151 to house those men. At Trudeau Institute I found places there where they said the cottages cost $20,000 apiece and should house four men. Now, as I understood, the reason for this was that charitably inclined people would make a bequest or donation to Trudeau Insti-

tute and require them to build houses as a monument to them. They had to be built very fine, but as near as I could find out, one was about as effective a house as the other so far as doing the patient any good was concerned.

Dr. SMITH. The tent houses at Fort Stanton are for the treatment of ambulatory cases, which in that institution would be suitable for a certain amount of exercise. The cottages at Trudeau are I think intended to cover the treatment during all stages of the disease. At Fort Stanton it was necessary to provide an expensive infirmary, and make provisions for semiambulatory cases as well as these tent houses which provided only for treatment of ambulatory cases. The cost of building the tent houses, of course, does not include the cost of the executive building and the infirmary, but only takes care of these ambulatory cases.

Mr. ELLIOTT. Did you ever see the Denver Y. M. C. A. detention colony?

Dr. SMITH. No, sir.

Mr. ELLIOTT. It was on a little farm just outside of the city of Denver. They had a farm house for an administrative building and the patients all used the same sort of tents. They were very cheaply constructed and they claimed to us that they had very, very good results from that place. Then over at the ——— Memorial Home they had very fine buildings that cost a lot of money and they were doing very well by their patients there, but I believe not any better than they were at the cheaper place, and we came to the conclusion on that trip that it was not necessary for the treatment of tuberculosis to build a big fine building.

Dr. SMITH. I think you saw different phases of the treatment. When you saw the tent houses you saw the patients who were ambulatory and when you saw the hospital you saw patients who required hospital treatment. A patient who this week is fit for ambulatory treatment may next week require bed hospitalization.

Mr. CHINDBLOM. When you speak of hospitalization, do you mean bed treatment?

Dr. SMITH. Yes, sir; tuberculosis runs in cycles, subject to periods of quiescence and to periods of exacerbation.

Mr. CLARK. What?

Dr. SMITH. Subject to periods of quiescence and then to periods of exacerbation when the disease makes progress.

Mr. CLARK. Doctor, you are talking to a lot of laymen and I think it would be better for you to explain as you go along so that we may better understand.

Dr. SMITH. A man at any stage of this disease is liable to have periods of fever and at those times he must be removed to a bed. Uniformly, all hospitals, such as Trudeau Sanatorium, and hospitals for the treatment of tuberculosis, have infirmaries for that treatment, and they are equipped for that treatment. After an indefinite rest in bed, his disease again becomes no longer active. After the doctor is sure that it is no longer active he can gradually be restored to the ambulatory stage and at such times occupy tent houses. He may take some educational training, but he must be watched and the infirmary must always be available to remove him to quickly if the disease becomes active. . . . .

Mr. CLARK. Doctor Smith, there is one other question that I want to ask you. You refer to apparent cures. Will you explain what you mean by that?

Dr. SMITH. The definition for apparent cures as laid down by the National Tuberculosis Association is a lack of physical signs, absence of physical signs, and apparent state of good health for three months.

Dr. BALDWIN. I do not know exactly whether Dr. Smith would agree with me in an answer to that question or not. In a general way that is true, I should say, the definition—these terms have been subject to a good many disputes among doctors and it is too bad—

Mr. CHINDBLOM. There is no chance for us if the doctors cannot agree.

Mr. CLARK. If the doctors cannot agree we are lost.

Dr. BALDWIN. I think, in a general way, Maj. Smith's statement about the absence of symptoms would mean more than the absence of physical signs, that if he were entirely free from any symptoms of the disease that he might be classed for a time, by using the term "apparently cured."

Mr. CLARK. Doctor, is there ever such a thing as an absolute cure?

Dr. BALDWIN. Well, I have been cured for 28 years.

Dr. SMITH. I have been cured for 14 years.

Mr. CLARK. Then, at what time can you tell that a man is absolutely cured?

Dr. BALDWIN. We have termed in our National Association's nomenclature that a man is called a cure; that is, a man is called a

cure or an apparent cure if after two years' living under normal conditions of his life's work, and living a normal life; that is, working and living in places in his old home under conditions and business such as he was before he contracted the disease, if he goes two years without a relapse we feel justified in classing him as a cure. He may then relapse, even then, but——

Mr. Clark (interposing). It is possible, but not very probable?

Dr. Baldwin. If he goes two years, in the majority of cases we feel pretty safe.

Mr. Chindblom. Let me ask you a question. Isn't it a fact that a large portion of the population at some time or other in the course of life have tuberculosis in a lesser or greater degree and they by natural methods effect their own cures?

Dr. Smith. Yes, sir; that is undoubtedly true.

Mr. Chindblom. When a man at some period takes a physical examination, the physician sometimes discovers signs of a previous tuberculous condition which has been overcome by nature itself?

Dr. Smith. Yes, sir.

February 5, 1920

STATEMENT OF DR. E. R. BALDWIN—Resumed

Dr. Baldwin. Mr. Chairman and gentlemen, I have been requested to come down here in the interest of tuberculous soldiers and service men from the standpoint of not only a tuberculosis specialist, but I might say also that of a patient myself, and also as interested in the management of an institution for the cure of tuberculosis.

The first question I think the committee will be interested in is the need for this hospital construction for tuberculosis. I take it that is the main question you wish to ask me. I have read this tentative draft of the bill and the features on which it is based. I might say briefly that practically every point I see here is very well taken, and the only comments I can make is that I fear it will be very inadequate. The program is inadequate at the best. The known cases of tuberculosis given on page 42 are 30,638. Then, there is an estimate of what will in all probability happen in the next 40 or 50 years. Experience has shown that of men who die between the ages of 20 and 40 in the average population, about one-third of the deaths are due to tuberculosis. The data which are given here states the low percentage of 1 to 7

deaths for all ages, male and female, which is hardly a fair estimate of the number of cases of tuberculosis that will take place. Granted, however, that an ex-service man is more vigorous than the average man when he was discharged from the Army a well man, we have perhaps a selected class of men to which a certain amount of allowance should be made for their good promise of health and expectation of life, as a life-insurance man would say. So far as tuberculosis is concerned the question may be asked as to whether this class of men discharged from the Army is as likely to develop tuberculosis as is an average population of men of the same ages. In my judgment that is a very difficult thing to determine. The vicissitudes of life have so much to do with the development of tuberculosis in individual cases that even the strongest constitution may break down. The weaker man who has been refused service in the Army may outlive him because of the fact that he takes better care of his health. The ex-service man is not noted as a rule for great care of his health. I may remark that in the experience of the Civil War and the Spanish-American War, tuberculosis has followed after years and has affected many veterans, but we must admit that the service men discharged from the recent war have a much better start. . . .

Mr. Smith. In asking for pensions for different soldiers on account of disability and disease acquired in after life, the department down here requires him to prove that it was contracted in the Army during his service. Now, I understand from your statement that it is your idea, and I do not disagree with you, that should one of these service men contract tuberculosis in after life, he still should be taken care of by the Government. I will ask you, if that is true, should not the same rule apply in case he should contract any other malignant disease or become disabled by the loss of an arm or limb—should he not also receive the care of the Government?

Dr. Baldwin. The logic of such a statement would be unanswerable.

Mr. Smith. It is called up by the fact that Civil War veterans have proved they contracted it in the Army.

Mr. Chindblom. The original law on which this is based requires that. This is aside from the main question, but later provision was established to take care of that.

Dr. Baldwin. The answer to that general question is the tracing back of the origin of tuberculosis to the service. Then it would have to take care of those who contracted tuberculosis in the Army.

Mr. Chindblom. Let me suggest that the present war-risk insurance law, I should say, also assumes the disability or illness to have been acquired in the service.

Mr. Smith. There is a new rule which does not apply in the Civil War veteran cases, because in the new war-risk insurance there is a hard and fast rule that a man is absolutely well when he goes in the Army but had a prima facie case in the Civil War Army.

Dr. Baldwin. My reference to Civil War veterans was perhaps misleading.

Mr. Smith. What I want to know is, is your thought that we should establish hospital facilities to take care of all service men whether their disabilities were acquired in the service or afterwards?

Dr. Baldwin. My own idea of that is gathered from discussion with various Army officers and officials of the War Risk Bureau.

Mr. Smith. And they think it should be?

Dr. Baldwin. They have taken the ground that it is so easy to prove and so difficult to disprove that a man got some injury or disability during his service which might add to his disability five years later. As to tuberculosis, it would be very difficult to establish the fact that a man did not get some injury in service, which in the case of arrested tuberculosis might come back ten years later and on the presumption that the service man will be given the benefit of any doubt as to the origin of his disease it seems to me that the estimate of future cases of 46,000 during the next 40 years probably is not sufficiently large, but it certainly is a safe one from my standpoint.

Mr. Andrews. May I offer a suggestion occurring to my mind as the doctor broached this question? I can see that there will be a great many tuberculosis patients in the future and hospital facilities will be needed for the entire country, but whether that is true or not, will it not be true that the Government will be obliged in future years to furnish facilities for any of these disabled soldiers, whatever their disabilities may be, who are in unfortunate financial condition and unable to care for themselves? Now, there is a margin it seems to me in that line that might take into account as a portion of the facilities that will develop but that might be provided for by the reduction in the demand in the years before we reach that point when the age of these men will demand care similar to that now furnished in the homes for soldiers. I just offer that as a suggestion that might be carried out. I think the gentleman from Michigan had certain

phases of this in view in relation to the Civil War. Now it will not be easy to prove where the disability originated.

Mr. SMITH. I am in favor of taking care of the disabled and needy soldier. I am in favor of looking after them in the hour of need.

The CHAIRMAN. Of course that is a point of the compensation policy of the Government. After a lapse of 25 or 30 years they extended compensation to soldiers without regard to the service origin of their present disability. That was done in the case of Civil War soldiers and is pending in the case of the Spanish-American War soldiers to-day.

Dr. BALDWIN. That was the basis of my estimate.

Mr. CHINDBLOM. I note in House Document No. 481, on page 17, in fact one of the officers called my attention to it, there is a paragraph relating to the need of medical care for those who carry life insurance policies issued by the Government. Is it your purpose to discuss that feature at all, doctor?

Dr. BALDWIN. On that feature I would be very glad to answer any question I might be able to.

Mr. CHINDBLOM. I presume it is a question of policy as to how far the Government should go in protecting itself in payment of the amount due on policies?

Dr. BALDWIN. I think it is absolutely sound business. The great State insurance policy of the German Empire was to prolong the working power of their men. It was an economic measure and by subsidizing their insurance companies they proved they could prolong that working power of their men to a certain extent.

Mr. CHINDBLOM. That would require periodical examination of the policyholders, would it not? How frequently?

Dr. BALDWIN. Once a year.

Mr. CHINDBLOM. Are there any policies written with this compensation feature requiring periodical examination?

Dr. BALDWIN. I am not aware of any companies in this country that issue policies of that kind, with the exception of sick benefit organizations and fraternal orders. Some large corporations like the Metropolitan Life Insurance Co. have features which approximate that in effect, that periodically their employees shall be subject to examination if they carry a policy.

Mr. CHINDBLOM. I note this statement on page 17: "Large life insurance companies have for sometime recognized this fact and are

endeavoring to have their policyholders kept under medical supervision and examined by the company's physician at least once a year, without regard to whether or not they are sick." I was wondering if there was anything of that sort in operation.

Dr. BALDWIN. I think you are familiar with the Life Extension Institute plan, are you not? This is a proposition largely financed by a group of the large insurance companies. Prof. Irving Fisher, whom perhaps you all know of, advanced this idea of examination periodically as being of benefit to the companies by prolonging their policyholders' lives; informing them early in the game whether they were in danger and have them take the necessary steps to protect themselves.

Mr. CHINDBLOM. Prof. Fisher is interested in stabilizing American life as well as American dollars.

Dr. BALDWIN. In my judgment the figures which are presented here and given in tabulated form on the last page are the best method of showing the gradual increase in the number of cases up to a certain age and their adding to gradually until the entire tuberculosis population should be reached. I am not able to criticize or suggest anything but I believe this is sound and based largely on the Prudential Life Insurance Co.'s figures of their experience with life at different ages.

The CHAIRMAN. That is supposed to be very accurate?

Dr. BALDWIN. I believe it is because the Prudential Life Co.'s figures relate to the average population. The next point I would like to touch on is the question of hospital and sanatorium features. Is it desirable that the Government should build or subsidize institutions for the treatment of ex-service beneficiaries? Emphatically yes. First because tuberculosis is a peculiarly insidious and also an infectious disease and for treatment to accomplish any valuable results, involves skill and intelligence, instruction and constant supervision to get the best results. Then a large number of these men are invariably advanced cases when discovered and will become bedridden invalids in the course of time. Provision at the present time is so limited and the attitude of public and private agencies to relieve tuberculosis with whatever help they may be able to give is so grossly inadequate that there is not any place to-day for any large number of the service men and the consequence is that the hospital and sanatorium treatment of these beneficiaries of the Government seems almost an absolute necessity. If there is any argument for the treatment of the insane service men,

there is also an actual argument for the treatment of the tuberculous service men. The more facilities there are for the tuberculous service men, for early diagnosis, for humane and proper care, the greater will be the reward of the country in recoveries and prolonged life and activity and it will more than bring back what is spent.

Another thing, Mr. Chairman, is that the advanced tuberculous patient who is unable to work much, if at all, is to-day a leper and is treated like a leper in a great many communities. If he has no home he is kicked about, and some of the municipal authorities treat him like a pauper, and I take it that the ex-service man and beneficiary of the Government is not going to be treated like a pauper. The public will not consent to it, and there will be not only a demand but a compulsion on the part of the United States Government to do something more than the average county supervisor or poor master will do. In some instances it is necessary to treat advanced cases in their homes, and these advanced cases are a menace to their families and to those surrounding them. The logical and proper thing to do is to put them in places where they cannot do any harm. This should be done with consideration; they should not be treated like lepers but should be given good care, good rooms, good food, proper nursing, and above all, intelligent medical supervision.

Now, what are the facilities to-day? I have been over the estimate here of the civilian institutions you have before you in this report here, and the number of public health institutions which is given here on page 2 is 2,400 beds in Government owned or leased institutions. Now, these, I presume, are mostly beds for advanced cases and do not contemplate treatment of the favorable tuberculosis patients.

Mr. Chindblom. What is it you are giving us now, available beds?

Dr. Baldwin. Available beds leased by the Government.

Mr. Chindblom. Are you taking your figures from page 2?

Dr. Baldwin. Yes, sir. There the estimate is given that 10,000 beds will be needed. As I stated in the beginning, there is a very large number of ex-service men to be treated. To begin with 10,000 beds are needed, and the question is, How many of these beds can be found among the present civilian institutions? There has been an attempt on the part of the Public Health Service to find as many beds as possible for immediate use. I made a study of the number of institutions and the character of them from the records given to me from the statistics contained in this report here, and in many

instances have personal knowledge of the institutions and their character, and while there are estimated to be something like 3,200 beds among the civilian institutions offered for Government purposes, it is evident that in the majority of these offers they simply shut out that number of civilians. They are full all the time and have a long waiting list all the time. I know, from your remarks yesterday, that you are all somewhat familiar with these conditions.

Mr. CHINDBLOM. The bureau estimates that there are about 3,200 beds now available in institutions?

Dr. BALDWIN. There have been more than that offered in boarding houses and places that are not institutions as such, simply nursing homes or boarding houses simply offering housing accommodations, places without any special control. In Colorado and other places there are many hundreds of service men who are not in any institution; simply went there on their own initiative, getting no particular treatment or care.

Mr. CHINDBLOM. Where are these 3,200 beds which you refer to?

Dr. BALDWIN. They are scattered throughout the country. As stated, there are 2,500 beds offered up to September. Dr. Smith, who has been in charge of the New York section, District 2 of the Public Health Service, tells me the majority of the beds offered since that report have been from small boarding houses.

Mr. CHINDBLOM. Do you know of any institutions that have heretofore been used for the treatment of alcoholism that are now available for the Public Health Service?

Dr. BALDWIN. I really do not; that is out of my field.

Mr. CHINDBLOM. I mean as available for the use of the Public Health Service. I think there are such institutions which are no longer being used for their original purpose. Might not such institutions be considered or offered for this purpose?

Dr. BALDWIN. I have not heard of any such offers.

Dr. STIMPSON. Dwight, Ill., has been offered to the service for lease, and I have a description of the property and a report from Dr. Smith, who reviewed the inspection report.

Dr. SMITH. None of these institutions is adapted to the care of the tuberculous in any way. Inebriates do not constantly need fresh air; they need supervision, very close confinement at times, and possibly care similar to the care of the insane. The institutions are all small, and the provisions are such as those provided usually for charity

cases; the locations are almost never suitable for the care of tuberculosis patients. The number of beds is negligible, because they are almost always adjacent to some existing institution.

Mr. CHINDBLOM. Would they be suitable for the care of any other class of patients?

Dr. SMITH. They might possibly be suitable for the care of psychoneurotics.

Mr. CHINDBLOM. There have been a number of institutions in the country that have been devoted to that work, and my understanding is that they are going out of business, or at least are reported to be going out of business.

Dr. BALDWIN. I feel, as far as that is concerned, that it is a mere drop in the bucket but might be used in the communities in which they exist for the treatment of tuberculosis if they can be altered for that purpose. They are certainly needed. The State of New York alone has about 50,000 tuberculous people not being cared for, and largely because of no proper accommodations.

Mr. ANDREWS. Does this estimate of 10,000 beds consist entirely of the immediate needs.

Dr. BALDWIN. Yes, sir; the immediate needs are only half cared for.

Mr. TAGUE. In the building of an institution, how large an institution should be in any one community?

Dr. BALDWIN. This is a matter of administrative policy but in my judgment it will be modified by the vocational treatment question. I second everything that Dr. Coop said yesterday and think this is the greatest opportunity to do more for tuberculosis than this country has ever done and to help these people. If he gets well but is not physically strong and cannot get a job, here is an opportunity where the institution can be made of help to fit the vocational needs of a neighborhood, especially where the large centers exist like Philadelphia, Cleveland, Cincinnati, Chicago, St. Louis; but suppose in that immediate neighborhood vocational treatment can be concentrated to meet the needs of that particular field. Possibly an institution of as many as 500 beds would be a desirable thing. In another place an institution of 150 beds would probably meet the requirements. That is an administrative policy but in my judgment it should be handled in connection with vocational training. We have a lot of tuberculosis wrecks that have never been salvaged. There are plenty of men capable of doing half a day's work, intelligent men, but there is nothing ready for them to do at present.

Mr. TAGUE. In what part of the United States are climatic conditions most suitable for these hospitals for the treatment of tuberculosis?

Dr. BALDWIN. That question is a very difficult one to answer. I believe there is something in climatic conditions but so far as treatment is concerned I believe it matters very little, provided you have salubrious air, freedom from smoke and dust and protection from strong winds. If a man has an arrested case of tuberculosis, by all means, if he can get occupation in a favorable climate, like the Southwest or the mountains, he should go there.

Mr. SMITH. Does altitude make any difference?

Dr. BALDWIN. It makes a difference in the coolness of the nights and has a certain physiological value. Vigorous races frequently come from mountain regions, but as Maj. Smith stated, provided they have proper supervision, one climate does as well as another. Institutions operated for 30 to 40 years have shown as many recoveries in bad climate as in good climate. Even in Pittsburgh, one of the small institutions produces cures right in the midst of smoke and dust, but it is not a pleasant place to take the cure.

Mr. SMITH. A good many of the institutions are making a hard drive and spending a great many million dollars in the fight against the white plague and a good many philanthropic men have contributed a large amount of money. Do you think the Government is behind in trying to stamp out tuberculosis?

Dr. BALDWIN. The Government has had absolutely no facilities.

Mr. SMITH. Are some of these institutions more advanced than others?

Dr. BALDWIN. Very much.

Mr. SMITH. In Michigan they are making a fight against it.

Dr. BALDWIN. They are making great progress there.

Mr. CHINDBLOM. Also in Illinois.

Dr. BALDWIN. Yes, also in Illinois. This, gentlemen, is another wedge for recognition in the Government for health purposes of hospitals for a certain number of men. To start with we must have enthusiasm and knowledge and the only way to do it is to start with the soldier problem. You have the people behind you; they want the soldier taken care of.

Mr. SMITH. What percentage of persons affected with tuberculosis is curable?

Dr. Baldwin. That is a very hard question to answer. Experience in the past has shown that about 50 per cent of the patients, as they come, can be put back in good health.

Mr. Andrews. Just at that point might I suggest that we could perhaps expedite matters and economize also, if coöperation could be developed on the part of the States and the Federal Government in relieving this condition, such as we have done with the soldiers of the Civil War. Each State go a certain distance and then the Federal Government go still further but the two coöperating might economize somewhat. I wondered whether anything had been developed along that line to show the possibility of coöperation.

Dr. Baldwin. In answer to that I have no facts to offer, except an offer on the part of the State Sanatorium of Missouri of beds they will set aside for soldiers and in that list of the entire number of States where there are beds offered there were 389 beds offered up to September.

Mr. Chindblom. What States are offering them?

Dr. Baldwin. I will try to give you that.

Mr. Smith. Can we not have that for the record?

Mr. Elliott. You say they have a waiting list now?

Dr. Baldwin. That is the statement I made previously. The superintendents of these institutions which have offered beds have not stated they have a waiting list but simply that they would take so many men but it is understood that a man would have to wait for admission anywhere from a week to three months. The States offering beds are New Hampshire, Vermont, Rhode Island, Connecticut, Pennsylvania (?), Maryland, West Virginia, Indiana (15), Michigan (20), Wisconsin (65). That is all. These are the only State institutions thus far that have offered any beds to the National Government for this purpose so far as this record shows.

(Note.—The number of available beds varies from week to week.)

Mr. Chindblom. I presume these offers are based on facilities available by these various States?

Dr. Baldwin. Yes, sir; these facilities are all available; the total is 389 beds. The idea or advisability of making some sort of a partnership between the State Government Commissions on Tuberculosis and the Public Health Service has been considered, I know, by officials of the Public Health Service but the difficulties are considerable; there are legal obstacles and the attitudes of the States have not been particularly liberal.

Mr. ANDREWS. You speak of legal obstacles. What legal complications could arise in a case like this: Suppose a State institution had 50 beds and the Federal Government paid the expense for the care of the patients occupying those beds?

Dr. BALDWIN. There would be nothing there, the only point is that none of these institutions has any extra beds for the care of soldiers.

Mr. ANDREWS. I have observed in this business that there is a feeling that the Federal Government should do everything and the State nothing and I would like to break down that feeling and make use of the maximum resources at command.

Dr. BALDWIN. The great problem of this, so far as a partnership between the State and the Federal Government is concerned, is, as I see it, the total inadequacy of this matter. The Canadian experience was that they found they had quite a big problem on their hands, and they had to get after it at once and make a big appropriation.

Dr. STIMPSON. On page 15, in the second and third paragraphs, we considered the methods that might be available. It is suggested that the Government build wards for the care of these patients in connection with State institutions for tuberculosis. Now, this is just a suggestion. Personally I do not believe that it is going to be practicable. State institutions are mixed institutions, for women and children as well as men. Now, these are young men, and if they are put with women and children it is hard to manage them. They are young men and do not want to obey the rules; do not want to do this, or to do that, which is essential for their cure.

Mr. ANDREWS. They do not want to do, and are not willing to do, things essential to their cure?

Dr. STIMPSON. I do not mean they are not willing, but it is hard to get them to do so.

Mr. ANDREWS. If they are not willing, how far should we go?

Dr. STIMPSON. They are all willing when they first go in. Another thing, the law fixes the rate which a State may charge.

Mr. ANDREWS. Laws are sometimes amended.

Dr. STIMPSON. Virginia fixed a rate of $5 per week, while the actual cost of one of our patients to-day is $14.97 per week at that particular institution.

Mr. ANDREWS. Does that mean it costs the United States more to do business than anyone else?

Dr. STIMPSON. No; I do not think so. Also it is not satisfactory to have a ward owned by the Government just attached to an institution where we have no control. There might be complaints about the food, nursing, and other things connected with the hospital, which we would be powerless to help, and the only thing we could do would be to take the patients away, and then it would be under the State management.

Dr. BALDWIN. The present civil institution is not only inadequate in accommodations, but all of Dr. Stimpson's remarks are very well taken as to their management. They are many times managed very unevenly. In some States political control has made serious difficulties.

Mr. ANDREWS. My investigations with committees have shown that it has cost nearly double in the hospitals under the Government to do the things that are done under the States. Right there is a point we will have to do some hammering on; right there is a point where economy must be insisted upon.

Dr. BALDWIN. That is an important consideration. On the other hand, these institutions are not managed very liberally in the matter of cost. They make the patients do a great deal of the work—make beds, polish floors, and do all kinds of cleaning work.

Mr. SMITH. There is a public hospital, St. Elizabeth; have you been there?

Dr. BALDWIN. No, sir.

The CHAIRMAN. He is speaking of a Government hospital.

Dr. BALDWIN. The tuberculosis patient who is allowed compensation by the Government is in a different category from the man who goes to a State institution without any money. He is more independent. A State institution, if built up and aided by Government appropriation, in my judgment, should be managed by the Government if that can be found feasible. I fully indorse what Dr. Stimpson says, that the difficulties of having them under civil management would be almost insuperable. The matter at this particular time of making more accommodations for tuberculosis people is so great and the importance of establishing proper and better standards of treatment and getting better results from treatment is a thing which expresses itself self evidently, and we are not getting the results from our State institutions that we should get. We need standardization and better treatment to set before these people, better medical care, better nurses, and vocational training.

Mr. Smith. Tuberculosis is both hereditary and contagious, is it not?

Dr. Baldwin. We do not at present use either of those terms. In the first place, tuberculosis is not hereditary in a sense. It makes very little difference to a child whether he gets tuberculosis before he is born, or from his mother's sputum after birth, or from surrounding conditions in his home.

Mr. Smith. I asked that for the purpose of making another inquiry; that is whether you think it can be stamped out.

Dr. Baldwin. I think it is being gradually reduced.

Mr. Smith. And ultimately can be stamped out?

Dr. Baldwin. Yes, sir.

Mr. Smith. And I understand from you that it is not hereditary?

Dr. Baldwin. No, sir; it is not. . . . .

Mr. Smith. If tuberculosis is not hereditary, what is the purpose of insurance companies inquiring so specifically whether any of your ancestors ever had tuberculosis?

Dr. Baldwin. Those insurance papers were found to be sound in practice, although unsound in theory and in reason. You asked if it could be stamped out. It is perfectly logical to expect a millenium of that kind, but not in our generation.

Mr. Clark. Are there any particular ages in life when people are more disposed to contract tuberculosis than at other ages?

Dr. Baldwin. By contracting you mean developing?

Mr. Clark. Yes, sir.

Dr. Baldwin. Yes, sir; between the ages of 16 and 30, the ages of greatest stress in life; the mentally active age of young men when they are undertaking business success; the athletic age, the age of adolescence, all come under that period. These are the periods of greatest stress.

Mr. Clark. What would you say of the probability of the development of the disease after 50 years of age?

Dr. Baldwin. No, in the great majority of cases. These life tables which you will find mentioned here show that after the age of 45 there are not many new cases. There are several reasons for this; the first is that the individual who has survived until 40 or 45 years of age has already overcome a good many opportunities for the development of tuberculosis. If he has achieved a competency he has more leisure and if he has not and is just drifting along, he has become adjusted to his

condition and if he has not developed it at 45 he is likely to live until 60. If he does develop it at the age of 45 or 50 the chances are that inquiry will show that he has recovered from it in early life. In the consideration of this problem of the ex-service men, the men who develop tuberculosis in middle life are the men who have had it when young but did not come under observation. There are instances of tuberculosis at 60 or 70 years of age but they are comparatively few.

Mr. MANSFIELD. How long may the germ repose in the human system before it develops.

Dr. BALDWIN. That is hard to say. A good many years may elapse between the recognition of the infection and the final development. If a young man gets a hemorrhage, say at the age of 15 or 16 years, and is immediately taken out of school and sent out west or to the mountains and gets well, he may years afterwards develop tuberculosis.

Mr. GRIFFIN. Is not a hemorrhage due in the first instance to tuberculosis?

Dr. BALDWIN. Yes, sir; and 50 years later that man may develop another case of tuberculosis. I have at the present time under treatment a woman 75 years of age and her first hemorrhage was when she was 16 years old, and she suffered a relapse from influenza four or five years ago.

Mr. GRIFFIN. That was independent of any new infection?

Dr. BALDWIN. Yes, sir.

Mr. GRIFFIN. So that in your opinion the germ may lie dormant for many years?

Dr. BALDWIN. Yes, sir. If we should be unfortunate enough to have great stress put upon us we might have a relapse.

Mr. SMITH. What is the most common way of getting it.

Dr. BALDWIN. Generally from bronchial affections or from stresses in the home.

Mr. SMITH. Not from a cold?

Dr. BALDWIN. A cold may activate it.

Mr. ANDREWS. What effect is likely to be produced upon the soldiers and the development of tuberculosis from the gases used in battle?

Dr. BALDWIN. Not anything special. Experience has shown that of those in the French, British, and Canadian hospitals during the war, and they began much earlier than we did, comparatively few developed tuberculosis as a consequence of gas.

Mr. Griffin. It was said during the war, Doctor, and made very much of, that these men were coming back with their lungs sloughed away.

Dr. Baldwin. That was due to burning, actual burning of the tissues. To revert again to this question of the kind of buildings, I would refer to the history of leprosy in Europe. This may be irrelevant, but it carries reason. A gentleman I have known, Dr. Jacobi, an old gentleman, once told the story to me about the history of leprosy in Europe. The leper, during the Middle Ages, was cast out by the authorities. He had the disease on his face and was very repulsive looking. There is a disease of the face called lupus, and if we had that disease on our faces you would want to put us somewhere we would not be seen. Leprosy in those days was regarded as a punishment for certain sins of their fathers and they cast out these unfortunate people and put them in barracks; some such as are being advocated by certain county supervisors for tuberculosis patients.

The leper was possibly willing to stay in those barracks during the summer, but as occasionally they would run away and go back home leprosy increased, or at least did not decrease; in other words, it was a false policy, absolutely unworkable. Dr. Jacobi stated that they began to think it over and committees of the different Governments of Europe decided they would build attractive places for these people to live in; so they began to put up a few cottages and buildings where they could have fun, gathering places that would attract any of us and then the lepers were glad to stay there and the result is that leprosy has gradually disappeared. Now, as a lesson, is there any better opportunity than in this country to set aside something within the resources of the United States for taking care of these tuberculosis patients? You will not keep your soldier in a place that is a barracks very long. It is shown here on page 43 that the average hospital patient spends 135 days in the hospital each year. The tuberculosis patient is usually industrious and resourceful, but he has nothing to do at present. Vocational training was never used in the past; there was nothing to interest him, and when he begins to feel better he is going to get away. Perhaps he is able to work a little bit, and wants to go back to work. Human nature urges him to get away from his surroundings; so why not in carrying out a plan for the cure of these ex-service beneficiaries have a program not only to take care of the man who is going to be saved and get perfectly

well and be an asset to the country? Fifty per cent of these men can be, but the other 50 per cent will be chronic invalids, in and out of the hospital. Give them good places to stay and they will be more in the hospital, where they can do less harm if inclined to be vicious or careless. If you will give them vocational training, it will perhaps lead to interesting work in that neighborhood by tubercular people.

Mr. GRIFFIN. What do you think of the establishment of farms for these tuberculosis patients?

Dr. BALDWIN. I am very glad you asked that question. In the experience of tuberculosis specialists the majority of men who have tuberculosis are not able physically to stand the severe labor and the exposure to the hot sun that farm labor demands. A certain proportion of them will, especially those who have been strong, vigorous men, but not the average. They could do gardening, poultry work, and tree planting perhaps, but when it comes to the harnessing of teams of horses or mules, digging in the garden, especially under the hot sun, brings on a relapse. I have had many instances.

Mr. ANDREWS. Are not the horses and mules disappearing?

Dr. BALDWIN. I find there are still a great many of them.

Mr. SMITH. Can you state what these other countries are appropriating to take care of tuberculosis patients? Can you mention the figures?

Dr. BALDWIN. I have not the figures. I was asked to go to Montreal for a meeting of the hospital commission. The chairman announced at the beginning of the conference—it consisted of physicians and tuberculosis specialists—that "whatever program you gentlemen recommend for the tuberculous soldier the Government is willing to go further." That was the sentiment and attitude of that meeting, but I do not know their present appropriation. England has been very liberal, but has not been able any more than we have to meet the needs of these tuberculous ex-service men. They have been unable to get buildings constructed owing to the drain of the war. They are willing to spend the money, however. As I stated above, whatever buildings the United States Government constructs, my advice would be, as a tuberculosis specialist and as a patient myself, not to put the tuberculosis soldier in a place you would not be willing to go yourself. That is the crux of the thing.

Mr. Griffin. Is it your idea that you would have different classes of homes or places for these men in accordance with the decrease of their disease?

Dr. Baldwin. Yes, sir; very decidedly.

Mr. Griffin. Places where they would be kept possibly another year?

Dr. Baldwin. Until they were well. The intermediate class: do not put him in with a lot of sick people; put him where there is some life. He does not want to be put with the dead ones. That is human nature. There is a third class, convalescents, who in the summer time, at least, would prefer to live in open tents or shacks; but if it is of permanent construction, I believe it should be substantial.

Mr. Griffin. Do you favor the building of large, stone structures, institutional structures?

Dr. Baldwin. No; I do not think them necessary.

Mr. Griffin. I do not myself, personally; I think it would be a very bad plan.

Dr. Baldwin. I think two-story buildings would be the most suitable. You do not want the patients climbing stairs.

Mr. Griffin. What is your idea about making colonies of cottages?

Dr. Baldwin. That is a very difficult matter. I believe it would probably be bad policy to attempt to build isolated cottages. I might say that in England they are attempting that scheme, colonizing all tuberculosis patients, bringing families to these cottages and making the men learn some vocation by which they will be self-supporting; but they give them facilities to carry on their work in that colony.

Mr. Griffin. Are you connected with the Public Health Service?

Dr. Baldwin. Only in an advisory capacity.

Mr. Griffin. You do not know, then, whether any attempt has been made, or is under consideration now, of conducting this work in connection with the vocational board?

Dr. Baldwin. I have been informed that arrangements have been made, but do not know how far they expect to go. I have prepared a statement here which I would like to submit, as to the beds available in different hospitals and sanatoriums.

State sanatoriums for tuberculosis offering beds at a per diem to the United States Public Health Service

STATE	NUMBER	AVAILABLE BEDS OFFERED	STATE	NUMBER	AVAILABLE BEDS OFFERED
Maine	2	10	Michigan	1	
New Hampshire	1	10	Connecticut	4	76
Vermont	1	10	Wisconsin	1	15
Massachusetts	5	10	Nebraska	1	20
Rhode Island	2	75	Iowa	1	50
New York	1	50	Kansas	1	
New Jersey	1	20	Missouri	1	
Pennsylvania	3	25	Minnesota	1	
Delaware	1		South Dakota	1	20
Maryland	2	60	Montana	1	40
Virginia	3		Wyoming	([1])	
West Virginia	2		Colorado	([1])	
Georgia	1		Utah	([1])	
Tennessee	([1])		New Mexico	([1])	
North Carolina	1	40	California	([1])	
South Carolina	([1])		Nevada	([1])	
Florida	([1])		Arizona	([1])	
Alabama	([1])		Oregon	1	
Louisiana	([1])		Texas	1	30
Mississippi	1		Oklahoma	([1])	
Ohio	1		Arkansas	1	24
Indiana	1	15			
Kentucky	([1])		Total	45	605
Illinois	([1])				

[1] No state sanatorium.

Compiled from the list of contracts on file as of January 31, 1920, at the Bureau United States Public Health Service.

Mr. SMITH. Doctor, you said that during the summer season tents would be a better place to keep them in than having them in the building.

Dr. BALDWIN. Only those who are practically beyond the stage of requiring treatment. They are convalescents, they are trusties, so to speak. They are men who no longer require particular supervision.

Mr. SMITH. What proportion of these that you mentioned as tuberculosis patients do they compose?

Dr. BALDWIN. I think a very small proportion.

Mr. SMITH. So there would not be very many that would not need open-air treatment?

Dr. BALDWIN. No, sir. The main policy, in my judgment, should be to build permanent structures for the entire number, and by having

these shacks or little cottages, or, rather, open-air shelters for sleeping out in the summer months, your facilities can be enlarged without any expense practically, and you can give a certain amount of gratification to the men which would keep them there longer.

Mr. Smith. Well, the actual practice of every one having tuberculosis up in our vicinity is that they get down in the South or Southwest as fast as they can, and a great many of them are cured in that way; but you stated, of course, that it can be cured any place in the country.

Dr. Baldwin. I believe that in a big scheme of this sort you could not anticipate removing your entire tuberculosis beneficiaries to any one State of the Union without great difficulty.

Mr. Smith. In a way there would be no benefit—

Dr. Baldwin. The ultimate effect, in my opinion, would be disastrous. I think the desirable thing to do, in regard to locating these institutions, is to have them near the ultimate home of these patients, and the men who have homes will be presumed to prefer to go back to their homes if they are cured, and yet there will be a large number who, in all probability, will seek a better climate, better surroundings, but the occupation will have a great deal to do with that. The unfortunate thing about the migration to the Southwest and places of that kind is that it is constituted, to a large extent—and I feel that I am quite correct, but Maj. Smith may correct me—it is constituted, to a large extent, of people who have no real open-air occupation and could not maintain themselves in a place without industrial conditions, industrial conditions which at the present time do not exist in those States, that you see in the large industrial cities of the East, where you have the tuberculosis development; and these people know how to do certain things, and they do not know how to adjust themselves to any new occupation, and when they go to the Southwest they can remain as long as their money lasts, but when it is gone they can not find anything to do, and the result is there is a big problem out there all the time of the migratory tuberculosis patients.

Mr. Griffin. What is your opinion in regard to the installation of these hospital and sanatorium facilities; that is, as to their location on high ground or low ground, in mountain districts, or contiguous to the sea?

Dr. Baldwin. I was just about to touch upon that point. It seemed to me that, as I stated yesterday, it has worked out in practice both in Europe, in England, and in this country, thus far, that insti-

tutions that are located not very far from the centers of population, on as high ground as is consistent with accessibility to sewer and water facilities, and so on; and country surroundings, where those institutions are located within a trolley distance of a large city; they are economically and practically more valuable to the community than in any other place.

Massachusetts has developed practically the largest system of tuberculosis control of any State in the Union. The distances are comparatively short there. They have a State sanatorium in the center of the State. It is comparatively easy to reach it. But in other States, in some like New York State, the institution there is 360 miles from New York City, and it is quite an expensive thing to send patients from New York City up there. Not only that, but if the patient happens to be ill and his family wishes to visit him, it is another big drain. These considerations are quite as important as the mere matter of climate, when you come to the practical year after year working out of your problem.

Mr. GRIFFIN. Is there anything essentially harmful in placing a man so afflicted near the sea or near sea air?

Dr. BALDWIN. Not especially. One of the best sanatoria in Norway is located over the sea. It is 1,200 feet above the sea, looking right down on the North Sea.

Mr. GRIFFIN. As a matter of fact, is not the consensus of opinion among medical men that the chief consideration is fresh air?

Dr. BALDWIN. Fresh air and management and the education of the patient. Do not misunderstand me. Of course, a bad day like this is not a desirable one upon which to sit out and enjoy a salubrious air in Washington.

Mr. GRIFFIN. But still you would get fresh air?

Dr. BALDWIN. You would get the results. It is not as desirable as to see the sun shine and to walk around in the dry air, but while a man is under treatment it matters very little as far as his immediate surroundings are concerned as to the weather.

Mr. GRIFFIN. Then, in your opinion, sunshine is also an element?

Dr. BALDWIN. It is an element of value, but not of such great value as has been estimated in some instances. I mean by that that if it were true that sunshine were essential to the recovery from tuberculosis, in the climate of Finland, for example, in the winter, where they have a sanatorium, the average sunshine there in the winter is two hours a day. You know, it is in an almost Arctic latitude.

Mr. GRIFFIN. Yes; it is right within the Arctic Circle.

Dr. BALDWIN. Yes, sir; and it has been found in actual practice that they get better results in the winter in this sanatorium in Finland with the steady cold air and the absence of sunshine most of the time, because of the Arctic night over there—they get better results in recoveries during the eight months of the cold weather than they do in the four hot months, when they have sunshine all the time.

Mr. GRIFFIN. That is due, perhaps, to the fact that they get more rest in that part of the year.

Dr. BALDWIN. In many ways the reason is that nutrition is better in the colder weather, and nutrition is the basis of the improvement. They eat more, assimilate food better, and they make their recoveries more rapid. That is being found so in Switzerland and in the Northern States of this country, such as Minnesota.

Mr. GRIFFIN. Doctor, you have not quite given a definite answer yet as to your opinion as to the preference, if any, between mountain resorts and seashore resorts or low ground or high ground.

Dr. BALDWIN. I think there is no question but what the interior, back from the sea, is preferable.

Mr. GRIFFIN. You think it is?

Dr. BALDWIN. Yes; to get away from the winds and clouds of the seacoast is desirable, but it is not so essential as was once thought. Most of you gentlemen know the former evil reputation of the Atlantic seaboard for tuberculosis. Those were days when bad climate and bad weather was thought to be the cause of tuberculosis. Now tuberculosis in England has diminished. The English climate is moist; they have very damp winters, rain practically all the winter.

Mr. MANSFIELD. And heavy, dense fogs.

Dr. BALDWIN. They have very foggy winters. Tuberculosis has diminished 50 per cent there in the last 60 or 70 years.

Mr. GRIFFIN. I am very glad to have a verification of that opinion, Doctor, because I find the opinion prevails that it is desirable to establish institutions and sanatoria of this character somewhere inland and on high ground.

Dr. BALDWIN. Preferably; yes.

Mr. GRIFFIN. There is a prejudice against having them near the sea.

Dr. BALDWIN. Well, I think it has justification up to a certain degree, but I do not feel that we should be influenced too much by the prevailing prejudice. The actual conditions of administration of these

institutions will have to govern a great deal in the matter of location, if I am not mistaken. A country place 10 miles from the nearest railroad, for example, might be a beautiful site, but if you put one of these institutions 10 miles out away from the trolley track or away from the railroad station, the men would not stay there; and perhaps there are other things.

Mr. Griffin. You could not get your doctors or nurses to go there?

Dr. Baldwin. As a matter of experience, they are not able to do it to-day in these county institutions.

Mr. Griffin. It is difficult to get your help?

Dr. Baldwin. The help will not stay. The quality of the help is very poor if it is in isolated places. On the other hand, the mere matter of the popular idea about the importance of sea air in aggravating tuberculosis is one that is very difficult to overcome, but fortunately experience has been had sufficient in this country thus far with all kinds of climates, and, as I just mentioned, in England, Scotland, and Ireland, which are also very damp and have maritime climates, right on the sea, we have experience enough now to answer those objections, and we can show we can cure tuberculosis anywhere.

For instance, if a man wants to learn telegraphy or wireless operating, and says he would like to go to Arizona to learn it, you can say to a man like that, "The wireless instruction place is 10 miles back from the sea, and we can not send you to Arizona." He would say, "I can not get well there." You could answer that statement and say, "Why can you not get well there? The doctors say you are a suitable case for this place," and the doctors will have discretion in special instances. There are certain types of cases that are better for certain climates, and they will doubtless have preference. The physician's advice will govern in that case perhaps as to where a man shall be treated, but as a principle the institutions, in my judgment, should be located at convenient distances from the large centers, where the vocational training can be carried out successfully in a perfectly proper way, where your personnel and your help will have access to a large center, and where you can run these institutions with some success.

Putting an institution in a desert, where the climate might be beautiful in a certain part of the year, is not necessarily a wise move. The popular idea of the average doctor is that the sanatorium should be placed in the middle of New Mexico somewhere. As I understand, Deming, N. Mex., has a camp which they have offered to the Public

Health Service. Granting that might be all right for the winter, Col. Bushnell, who is head of the tuberculosis department of the Army, now admits himself, and I have been told by Public Health Service officials, that Camp Cody was absolutely unsuited for a tuberculosis sanatorium. The main, first reason is that it is too hot there in the summer, and the wind and dust there is very violent. Those are the principal objections; even if they were not enough, those barracks will never house sick men properly. They will do very well for a winter vacation, possibly, for a certain class of men, but when you come to make a plan for 25 or 30 years, you will have for this problem, a wise and statesmanlike plan, or a logical, scientific plan. Those things are mere makeshifts, likewise the tent colonies, likewise the open-air shacks.

Some of the States and counties have adopted that plan, and have become disgusted with it. New York City advocated a county hospital plan. They have already informed me recently that they have abandoned the idea of county hospitals, because they cannot get personnel in the small places; they cannot get the doctors, nor the nurses, nor the help to stay there, and the patients will not go there unless there is a good organization to go to.

Mr. Griffin. A man afflicted with tuberculosis, even in the incipient days, is in no shape to become a pioneer?

Dr. Baldwin. That is the point. He may ago away and get away with it. He may go fishing and hunting, and may be a well man, but the chances are that he will get a hemorrhage, pleurisy, or pneumonia, and come back a dead one. . . .

Mr. Clark. I would like to ask one question of the doctor. Do you want the committee to understand, from your last remarks, that you advocate the establishment of these institutions only near large cities?

Dr. Baldwin. No; I think there are places that are accessible to small places, to small communities, railway centers, not large cities—

Mr. Griffin. I understood the doctor to say that you favored establishing them contiguous to centers of human industry or life, whether large or small. I did not take it that the doctor meant contiguous to large cities.

Mr. Clark. I think he made that clear in the record. I do not think you meant to say that.

Mr. Griffin. Contiguous to a small city would work just as well, would it not?

Dr. Baldwin. Yes, and that is what I intended to convey.

Mr. Griffin. I am anxious for the doctor to set that right on the record, because, coming from a large city, my colleagues would think that I was looking after the interests of the large cities.

Dr. Baldwin. I think, as a matter of administrative policy and the success of vocational training, that the larger number of patients would be in the large centers, and that the administrative management of these institutions will be more successful in proportion to their nearness to large centers. The opportunities for vocational training, and also the opportunities for employment after they have been discharged from the institutions will be near at hand.

There is one point, however, that, Mr. Chairman, I did not go into, and that is the after care of these men, and that leads me to say that the discharged man, who has an arrested case, constitutes another very serious problem, entirely independent of the sanatorium and hospital, etc. Proximity to a center, a large or small city, is an important thing, because in the cities the Public Health Service contemplates maintaining a staff of men to follow the man who has been under treatment in their hospital. A follow-up social worker, or a physician, or a nurse will keep track of a man after he is dismissed and see that he is not falling back; that he is not retrograding from his good condition.

Furthermore, in that center where the dispensary or station or consulting physician will be situated, this man will be in touch constantly from year to year, and month to month, possibly at first with the doctor, or with the welfare worker, or with the dispensary, and he will assure his recovery, where otherwise if he is lost to the service, lost to the Public Health Service, he by and by relapses and then is readmitted as an advanced case.

Now, as I said, the salvage of the tuberculosis wreckage in this country has never been undertaken intelligently, adequately, nor has there ever been any serious effort to find occupations for the men after they have been discharged;—no kind of effort. And employment for the tuberculous will be a very important part of this scheme, as I said, in my opinion. As I said, England is contemplating establishing colonies with industries near the sanatorium, whereby a man who is under treatment will get the idea that he is a live man, and if he will learn that particular trade or industry he can be graduated into it and get a good paying job.

Those are all important in connection with the establishment of these institutions near some center—I do not say a large city.

Mr. Smith. In that connection, I understand from your testimony that you are favorable to a large hospital where they can be confined in one building largely, rather than in separate cottages or in a colony. Which would you say would be the best for the treatment of patients, the large building where they would all have wards and be in one building and be treated, or that they should have cottages and be treated separately?

Dr. Baldwin. I think the various features of the construction should be combined in the same institution.

Mr. Smith. It should be one institution, you think?

Dr. Baldwin. One institution—that is, a large infirmary sufficiently large to take care of every man if he was sick in bed.

Mr. Smith. Under one roof?

Dr. Baldwin. Under one roof, perhaps, or at least pavilions or separate buildings for the intermediate man who is not confined to bed, but who can be up and about, and who would have a different kind of place to live in and sleep in than the man who is in the infirmary; and third, as I said, possibly not to a large extent, but in summer months particularly, this temporary construction of tents or shacks for sleeping-out purposes chiefly.

Mr. Smith. Were you ever in the Walter Reed Hospital here?

Dr. Baldwin. Yes, sir.

Mr. Smith. In case that it is available—of course it is not available now—but in case it would be, for comparison, as a specific case, would you say that would be a hospital that could be converted into a sanatorium?

Dr. Baldwin. I would hardly consider that to be a good foundation for a sanatorium. It would, however, be absolutely suitable for an infirmary.

Mr. Smith. The construction of the buildings?

Dr. Baldwin. Oh, yes. I think whether the buildings are made of stone, or brick, or concrete, is a matter of study by the architects, with a view to economy, but at least make them permanent and attractive.

Mr. Smith. But not necessarily expensive?

Dr. Baldwin. No.

Mr. Griffin. On this dispensary feature two sections of the bill are taken up with various authority to the Secretary of the Treasury to provide necessary out-patient dispensary care and treatment, and

out-patient dispensary facilities for the beneficiaries of the Public Health Service. The point I want to get at is this, that in most of the large cities there are many hospitals which have dispensary facilities, and those dispensary facilities are absolutely free. Anyone may go and be examined and treated. Now, do you consider that it would be necessary to have anything in the way of dispensary facilities in the large cities where those facilities already exist?

Dr. BALDWIN. In connection with tuberculosis, of course, you are speaking of now? This covers all the other diseases as well.

Mr. GRIFFIN. Yes; this covers all the diseases.

Dr. BALDWIN. I think in the large cities most of the tuberculosis dispensaries to-day that I have any knowledge of are not places that the average service man will go to.

Mr. GRIFFIN. No; they are not tuberculosis dispensaries. I do not know of any institution in New York City—

Dr. BALDWIN. Yes, they have numerous—

Mr. GRIFFIN. That is what they call a tuberculosis dispensary?

Dr. BALDWIN. Yes; there are a number of them there.

Mr. GRIFFIN. They have a dispensary in connection with the hospital, to which persons may go and be examined, and if tuberculosis is the diagnosis then they are sent to a suitable institution to be treated?

Dr. BALDWIN. Yes.

Mr. GRIFFIN. But any man, whatever his ailment, may go to any one of these dispensaries?

Dr. BALDWIN. Yes.

Mr. GRIFFIN. And in a mild case may be treated. I know that in the Bellevue Hospital in New York City they have a dispensary, and they treat from day to day many persons in the incipient stages of tuberculosis, and furnish them with the medicine, and Fordham Hospital in the Bronx and other hospitals in the Bronx also have the dispensary feature.

Dr. BALDWIN. They have very good dispensaries in some cities. Take for example, in Pittsburgh.

Mr. GRIFFIN. And in Philadelphia?

Dr. BALDWIN. And in Philadelphia and Chicago. In the Phipps Institute in Philadelphia they have a dispensary, but for a class of patients who are absolutely without means and also the service man who is entitled to governmental care. You could, of course, make arrangements with certain desirable dispensaries to have a man examine and passed upon if there was no Public Health Service man there.

Mr. Griffin. Doctor, pardon me. Let us get this right now, Mr. Chairman. I do not think we ought to busy ourselves with devising schemes of spending money where the expenditure of the money is not absolutely necessary. Now, take the soldiers of the National Army who have been demobilized and sent to their respective homes. They have never ceased to be citizens of their respective cities, counties, or States, and the city, county, and State owe them a duty, and they do not owe them any less duty because they have in the interim of a certain absence from the State served their country and come home with certain disabilities. I do not think it is the intention of the cities or counties or States to cut off these men from the opportunity to obtain the advantages and facilities of these hospitals. Those local units have no such idea of cutting off these men, and they are making a stand on ceremony to preclude them from receiving treatment, and why should our Federal Government undertake to take something off their hands which they do not want taken off their hands?

Dr. Baldwin. I think that the gentleman is much better able to discuss that point than I am, but I will say this, as I understand it from the conversations that we have had, that in the large cities, at least, and the large cities are the only places where these tuberculosis dispensaries exist, the Public Health Service has machinery in existence, consulting physicians already in their service to whom these men should properly go.

Mr. Griffin. But if they do not go to them there should be no prohibition against them going to the hospitals with which they are familiar?

Dr. Baldwin. Not the slightest, and they are doing that to-day, I am sure, all the time.

Mr. Griffin. Take the Bellevue Hospital in New York City. It is in the center there of a radius that contains 500,000 people, and they all patronize it—within practically walking distance of it.

Dr. Baldwin. I think that these gentlemen can answer this question about the dispensary program a little better than I can but I would say that I see no objection to a man getting his diagnosis from a tuberculosis dispensary operated by the municipality or by a private concern.

Mr. Griffin. There is no disposition upon the part of the cities to waive any responsibility in the matter, and there is no immediate necessity for the Government now to make an outlay for dispensaries.

Dr. Baldwin. I feel that whatever is done a man should not be lost sight of after he leaves the sanatorium.

Mr. GRIFFIN. In other words, the thing that is most vital, Doctor, at this time is to provide places for these men keenly and deeply infected or debilitated?

Dr. BALDWIN. In my opinion, the important thing is to find the men before they get sick and incurable, and they are getting incurable every day for lack of proper care. They do not go sufficiently early to these free dispensaries, as a rule; they go to some doctor, and he may forget, or not discover the disease. They are entitled to a skilled tuberculosis examination such as they give at the Walter Reed Hospital here.

Mr. GRIFFIN. Were they not all examined before they were discharged?

Dr. BALDWIN. But they have developed the disease fresh since. They are developing it every day, new cases.

Mr. GRIFFIN. You do not know how many cases of that kind there are, Doctor?

Dr. BALDWIN. I have these records here.

Mr. GRIFFIN. Or does anybody know?

Dr. BALDWIN. Nobody knows, but the point is that there are men walking the streets to-day who have tuberculosis developing right now. They are developing it as a consequence of the recent influenza epidemic, the one that occurred a year ago. They were discharged from the Army well, but they have become ill since, and they have drifted along six months or a year without a diagnosis. In my judgment, it is the duty of the Government to find that man before he is a wreck, and the only way we can find him is to give him the facilities and make him understand where he can get those facilities, whether it be through a private dispensary or a municipal dispensary, or the Public Health Service dispensary, establish some machinery by which that man can be caught early and saved before he gets into the chronic stage of tuberculosis.

Mr. GRIFFIN. But, Doctor, in those cases, they cannot claim that the disability is due to their service.

Dr. BALDWIN. On the other hand, it has been reiterated that the benefit of the doubt will always be given the man.

Mr. GRIFFIN. Men who happened to catch the "flu" this last year, after the war was over, and then developed tuberculosis since, might just as well have developed it if they had been engaged in any other occupation, and had never served their country at all. I do not want it understood that I am opposed to giving them all the consideration in

the world, but what I want to emphasize is this: We ought not to spread out too much, or get too ramifying in and out, but we ought to look after the most urgent needs first, and the most urgent thing now, it seems to me, is to care for those who are absolutely in need of attention.

Dr. Baldwin. That evidently is the first duty. On the other hand, there is no disease except insanity, as the gentleman showed yesterday, where an early diagnosis is so important as in the case of tuberculosis. Are you not going to save many millions of dollars by getting a diagnosis early? Is it not a scientifically sound proposition to find the disease early?

Mr. Griffin. Doctor, I am not arguing with you on that. I do not a take a contrary view as to the importance of that, not at all. I am not averse to doing that, but I do not think we ought to emphasize the dispensary feature at this time.

Dr. Baldwin. I think these gentlemen here can speak on that much better than I can.

APICAL COLLAPSE IN THERAPEUTIC PNEUMOTHORAX

HERBERT F. GAMMONS

Dallas, Texas

This case is especially interesting on account of its rarity and also because of the results following partial collapse of the lung. Furthermore it shows what results can be obtained in bilateral pulmonary tuberculosis when a patient is in a critical condition.

Mrs. M. J. M., sixty years old, entered the sanatorium June 13, 1919. Previous history unimportant. In September, 1918, patient had epidemic influenza and began to cough. Symptoms increased in severity and on entrance patient was running a temperature ranging between 100° and 104.6° F. Cough was very severe and sputum large in amount, of a purulent nature and positive.

Physical examination showed a scattered inflammatory condition in the right lung with an ulcerative and apparently rapidly advancing condition in the left.

Pneumothorax was recommended and on June 24 the initial instillation of 500 cc. was given in the left pleural cavity. This treatment was repeated every few days and then every week until the present time. Physical examination before and after treatment always showed an adhesion at the left base in the axillary line with large air space at the top (fig. 1).

At present the patient is running a normal temperature and pulse, has no expectoration or cough and has gained twenty pounds in weight.

Following the last few injections there has been a slight increase in temperature and pain in the region of the adhesion in the left side. This temperature rapidly subsided and according to the X-ray plate we have compression of the lung at the apex.

Fig. 1

EDITORIAL

THE PLACE OF THE SANATORIUM IN THE STUDY OF TUBERCULOSIS

Those who have been in sanatorium work for the last two decades have seen kaleidoscopic changes. Twenty to twenty-five years ago the sanatorium was the only agency for combating tuberculosis. At that time it was considered necessary only to provide a sanatorium bed for every early case in order to stem and eventually to eradicate the disease. The spitting ordinances were not enforced, the National Tuberculosis Association had not been formed and its work of propaganda had not awakened interest throughout the land. A few years later a prominent worker prophesied that in fifteen years tuberculosis would be conquered and would be in the position that smallpox has long occupied. Permanent sanatorium construction was then condemned.

As time passed by, inquiries were made in regard to the results accomplished by various tuberculosis agencies, and especially by the sanatorium, as it was the oldest. "Is the sanatorium worth while?" was a frequent topic, for it was seen that, from more extensive investigation, it would never be possible, if indeed desirable, to house all patients with pulmonary tuberculosis in sanatoria in contradistinction to hospitals. Then again studies were made of patients of limited means who on their return from the sanatorium were forced to resume work under more or less favorable conditions. Some retained health or at least working ability, while others quickly relapsed and again sought relief for themselves and their families. Sanatorium statistics accumulated; and pulmonary tuberculosis was found to be eventually a very fatal disease; for after twenty years 82 per cent of the patients treated were dead and 90 to 95 per cent of these had died from pulmonary tuberculosis. This again brought the value of the sanatorium into the balance and seemed to indicate rather forcibly that either the sanatorium was not conducted properly, or needed other agencies to carry on the work of restoration it had begun.

The limitations of the sanatorium are recognized to-day by workers in tuberculosis more clearly than the possibilities and the opportunities for advancing the tuberculosis cause that the sanatorium possesses.

It is a curious fact that many tuberculosis workers have great difficulty in grasping the idea that pulmonary tuberculosis is a chronic disease which temporarily responds rather readily, in many instances, to more or less efficient treatment. Patients also cannot grasp this phase of the disease. For these reasons it has become apparent to many workers that the teaching side of these institutions must be better developed. Encouraging success has been met with along these lines and to-day few institutions fail to give their patients "educational" courses in pulmonary tuberculosis.

It is a psychological truth that no one knows a subject until he has tried to teach it. It is also interesting that patients with pulmonary tuberculosis are often eager to be used as subjects for teaching. They like to see the beginner in physical exploration show signs of perplexity, and some even venture suggestions as to how they should be examined. In developing percussion Auenbrugger worked on many patients with pulmonary tuberculosis and Laennec chiefly used such patients in working out his masterpiece on auscultation. Good material for teaching is therefore always at hand in the sanatorium.

Many institutions may wonder where they can get students. "Who," the superintendent says, "would care to come to study with me?" The question may be aptly put, and the answer lies in the way the institution is conducted.

Many states have passed laws which compel the erection of one or more sanatoria. To-day there are millions of dollars invested in these institutions all over the country, and the sanatorium physicians will some day be called to account for the stewardship of these vast sums. Their first duty, without question, is the proper care and education of the individual patient, but unfortunately many seem to think that their duty ends there. Even so, this routine work can be so individualized, so carefully performed, so perfected, that any person who wishes to study pulmonary tuberculosis can gain much knowledge in assisting to carry it on. The sanatorium to-day owes a debt to many patients who perchance can never by any possible means gain admission to its beds. To reach these one of the duties of all sanatoria should be to set apart one or two rooms when the occasion requires for third or fourth year medical students, or for physicians, who wish to study or to brush up their knowledge of pulmonary tuberculosis. The training of such workers, to act as leaven to raise the standards among the body medical, is an ideal that all sanatoria should strive for, and most can attain.

The "Edinburgh tradition," which was introduced into Canada about the middle of the last century, and carried by Osler to Baltimore, brought the medical students into the wards to take the case histories and to study the patients. The results of this system have been the production of better records and more careful work. Overworked internes were relieved of much routine, and opportunity was afforded for investigation and original research. The younger men introduced much enthusiasm into work which for others proved at times a drag. This system is to-day gaining ground throughout the Anglo-Saxon world.

Sanatorium authorities often fail to realize the deadly monotony of life in these institutions. They frequently understaff the sanatorium, and expect the medical man in charge to do much executive work. Routine medical work, which often demands all the time of the staff, can even then never be brought up to date. Such demands in time not only prevent reading or study; but all initiative is strangled, and the routine work is often rushed through in a sorry manner. Occasional voluntary workers, or one or two medical students are often keen to learn about tuberculosis, and much routine work can safely be turned over to them. In this way the "Edinburgh tradition" can be made of great value to the sanatorium, the medical knowledge of tuberculosis disseminated, the immediate patients helped, and many future sufferers from pulmonary tuberculosis, through early diagnosis and proper treatment, restored to years of useful labor.

It is a no less curious fact that routine work is always better done when the staff of an institution keep their heads so far above water that they can see the horizon, that the perspective and proper relation of work can be clearly visualized. No man can work all day without let up and then read every evening. For a time this may be possible, and the interne in a great hospital may but rarely does accomplish it. The American Sanatorium Association took cognizance of this fact several years ago, and appointed two committees to draft the minimal requirements in the routine clinical and laboratory work. The object of these reports was to define clearly what at that time seemed to be essential. It was hoped that by insisting only on the essentials in institutions, which to say the least were not overstaffed, the residents could find time for work and study and investigation.

Tuberculosis problems are far from being exhausted. Etiology has long been considered as fairly well settled but only a little study, a little questioning, will reveal many gaps that need to be filled up. The very

fundamentals upon which the treatment of pulmonary tuberculosis is based to-day, rest, abundant food and large doses of fresh air, could wisely be investigated, and might yet lead to a modification of many of our methods of treatment.

It must always be borne in mind that the majority of sanatorium workers in this country are not healthy men and cannot be expected to do the work of well men. They need more assistance. On the other hand it must also be remembered that the reputation of the sanatorium workers rests upon these men. With the exception of some dispensary physicians, who are usually only part time men, and a few workers in one or two tuberculosis institutes, the sanatorium physicians compose the greater mass of all the tuberculosis workers, and upon them depends the tone and quality of the tuberculosis work that will be done in the next decade.

The time has come when dozens of sanatoriums throughout the country have passed beyond the stage of organization, beyond the period of trial. They have reached a level on which they do much good. What is to be the future of the sanatorium movement in America? It cannot remain stationary. We cannot see it go back. We must plan for its advance along sound lines, along lines that will mean the most to the people. To some of us it becomes more and more clear that the real study of tuberculosis must be undertaken in the sanatoria. Their workers must fit themselves for this work, and no method is so good as an attempt to teach tuberculosis; for teaching demands study and thought. Then will follow research and progress. The sanatorium will be worth while, and the medical profession and the people will give honor to whom honor is due.

In conclusion let us recall that it is not the work accomplished that benefits the worker and the cause, but the work attempted. To attempt and to fail is no disgrace. To fail to attempt cannot be condoned.

L. B.

THE UPPER AIR PASSAGES AS AN ENVIRONMENT FOR BACTERIAL GROWTH

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In dealing with the study of infectious diseases, students have concerned themselves mainly with two phases of the problem, first, the demonstration of the association of certain organisms with a particular pathological process, and second, the elucidation of the mode of transport of the virus from one individual to another. Relatively little progress has been made, however, in solving the important question of just what circumstances make invasion possible when the infecting agent and the host have been brought together. Actual analysis and definition of the exact conditions which enable the organisms to survive, multiply, invade, and produce disease are usually avoided by falling back on such terms as the "virulence of the organism" and the "resistance of the host." And yet a knowledge of these predisposing conditions seems essential to further advance in the understanding of infection. In the case of lobar pneumonia, for example, it seems quite clear that the pneumococcus is usually the disease producer. The transmission of the organism directly or indirectly by means of the sputum from one person to another is also proved. But only an insignificant percentage of individuals in contact with cases of lobar pneumonia themselves develop the disease (1). This "resistance" is certainly as a rule not due to failure to acquire the pneumococcus but to some combination of circumstances which operates to prevent the organisms from invading, or perhaps to the lack of some essential favoring condition. Pneumonia is of special interest in this connection because it is a relatively common disease and still one which requires special circumstances for its successful initiation. Infections with such an organism as the Friedländer bacillus illustrate the fact that bacteria, which so rarely produce disease as to be practically negligible in human pathology, still may occasionally set up a severe and fatal form of infection. Some very special set of favoring circumstances is clearly required before this organism can become pathogenic. In measles on the other hand, if it may be assumed that the virus enters

by way of the respiratory tract, little or no opposition is offered to the production of disease in an individual who has not had a previous attack; invasion seems to be invariably followed by infection. It seems clear then that conditions vary with different organisms, but in almost every case some circumstances other than the mere presence of the virus seem to be necessary for the initiation of disease. In other words the essential problem of the mechanism of infection is that of the exact fate of the organism after its arrival at the host rather than its means of transport from one individual to another, however important the latter may be.

While the study of these questions is attended with difficulties which appear insoluble by the methods at present available, it has seemed that some general information as to the fate of bacteria in the upper air passages might be obtained by actual inoculation and subsequent study of the disposal of the organisms introduced. During the past year a systematic study along these lines has been carried out using various bacteria,—sarcina lutea, staphylococcus albus, B. coli, B. influenzae, B. Friedländer, and S. hemolyticus.[1] The present report is a summary of the work up to the present time and an outline of such conclusions as are suggested thereby.

The method of procedure with the various bacteria was essentially the same. Large amounts of growth (usually a platinum loopful of solid growth) were smeared on the tongue, pharynx, nasal septum, and into the tonsil crypts of individuals free from unusual abnormalities of the upper air passages. Cultures were made from the various sites at frequent intervals and the disappearance of the bacteria observed in this way. The general nature of the results is summarized in table 1. The striking fact which becomes apparent at once is that the various organisms all disappeared as a rule within twenty-four hours. The occasional exceptions where the bacteria were still recovered after two to three days are of interest and their probable explanation will be taken up below. It should also be emphasized that in no case was any demonstrable local lesion or general reaction set up.

The unexpectedly rapid disappearance of the inoculated bacteria led us to seek some information about the mechanism which was responsible for their disposal. In a previous paper (2) the literature bearing on this subject was reviewed and the various possible factors were enumerated. It was pointed out that one must consider the flushing action of the

[1] The work with B. Friedlander and with S. hemolyticus is not yet completed

TABLE 1

Rate of disappearance of bacteria introduced into the upper air passages

ORGANISM	TIME OF DISAPPEARANCE AFTER INOCULATION ON THE TONGUE	TIME OF DISAPPEARANCE AFTER INOCULATION ON THE NASAL SEPTUM	TIME OF DISAPPEARANCE AFTER INOCULATION INTO TONSIL CRYPTS	TIME OF DISAPPEARANCE AFTER INOCULATION INTO PHARYNX	MECHANISM OF DISPOSAL
Sarcina lutea	10 minutes to 2 hours	Less than 24 hours (in one case a few colonies recovered after 24 hours)	Usually less than 1 hour. Always less than 24 hours	Less than 1 hour	Promptly destroyed by saliva
B. coli	Less than 24 hours (in one case in from 24 to 48 hours)	Less than 24 hours (in one case 1 colony after 24 hours)	24 to 48 hours	Less than 24 hours (in one case 1 colony after 24 hours)	Removed mechanically
Staphylococcus albus	Usually in less than 24 hours	Usually 24 to 48 hours	24 to 48 hours	Usually less than 24 hours	Removed mechanically
B. influenzae	Usually in less than 24 hours (in one case a few colonies after 24 hours)	Usually less than 24 hours. In every case in 48 hours	Less than 24 hours	Usually less than 24 hours. In every case in less than 48 hours	Removed mechanically. Growth also inhibited by saliva
Friedländer bacillus*	24 to 48 hours or less	24 to 48 hours or less	24 to 48 hours or less	24 to 48 hours or less	Removed mechanically
Streptococcus hemolyticus*	Less than 48 hours	Less than 48 hours		Less than 48 hours	Removed mechanically

* Experiments with this organism not yet completed.

mouth and nasal secretions with the associated acts of swallowing and expectoration, chemical action such as the reaction of the saliva, and biological effects such as phagocytosis and the antagonistic effect of bacteria already present in the mouth. The theoretical discussion presented at that time can now be amplified by a more real evaluation of the importance of these various factors. The mechanical flushing action of the secretions seems undoubtedly the most important element in the disposal of bacteria introduced into the mouth and nose. The rapid disappearance of hardy organisms such as B. coli and B. Friedländer, which survive for days in saliva in vitro, can hardly be explained in any other way. The demonstration of the rapid removal (less than twenty-four hours) of inert particles such as kieselguhr when placed in the nose or on the tongue or in tonsil crypts supports this idea (3). Next in importance seems to be the fact that saliva in many instances is an unfavorable medium for bacterial growth. Influenza bacilli for example suspended in fresh saliva are no longer viable on artificial media after twenty-four hours (4). The exact nature of this unfavorable action is uncertain. It cannot be attributed to any specific quality of the saliva such as reaction (5) but must relate to the general composition of the medium. In other cases the secretions exercise a prompt and direct destructive effect on bacteria (sarcina lutea (2)). The particular factors which seemed to be important in the disposal of the various organisms are summarized in table 1. In general then it may be said that the disappearance of the bacteria studied was due to the rapid flushing action of the secretions, together with a more or less unfavorable environment which offered no chance for colonization. The few instances in which organisms persisted for over a day are of interest in this connection. It seems probable that some anatomical protection such as a temporary pocketing in some crevice in the mucous membrane prevented their prompt removal. The absence of production of any carrier state after introduction of organisms into tonsil crypts also requires explanation, but this does not seem remarkable when one considers that tonsil carriers usually follow inflammation of the glands and that the bacteria are located in the depths of the diseased crypts and not in superficial crevices alone.

The experimental demonstration of the rapid disappearance of certain bacteria introduced into the upper air passages raised the question of their significance when encountered naturally in healthy people. It seemed that a careful study, over a considerable period, of the bacteria

present in the mouth of a given individual might enable one to differentiate between such organisms as constitute a true mouth flora in the sense of being constantly present and those which, while occasionally present, disappear promptly and are to be regarded as transients rather than real inhabitants. A study of this question is now in progress and while not yet complete the following tentative conclusions may be drawn:

1. There are certain bacteria which seem to constitute a true mouth flora in the sense that they live and multiply and are almost constantly present in most people and persist from day to day over considerable periods of time. Among them may be mentioned particularly a green streptococcus which grows in long chains, certain diphtheroids and various members of the Gram negative coccus group. The position of the influenza bacillus and the pneumococcus is not yet clear.

2. Another group of organisms may be occasionally recovered from the mouth but as a rule these are present only for short periods of time. They seem to be bacteria which are essentially transients and fail to colonize or to survive on normal mucous membranes. In this group we have found staphylococcus albus, various pigment forming "air bacteria," spore bearing "air bacteria," and such potential pathogens as streptococcus hemolyticus, pneumococcus, and others.

3. Occasional individuals are encountered who "carry" over considerable periods of time organisms which do not belong to the normal true mouth flora such as streptococcus hemolyticus, B. diphtheriae, meningococcus, B. Friedländer and others. This carrier state often follows a recognized infection and is associated with the persistence of bacteria in the infected tonsils or nasopharyngeal lymphoid tissue.

These facts are in harmony with the results obtained from the experimental inoculations described above.

DISCUSSION

Before discussing any possible general conclusions which may be drawn from these observations on the fate of bacteria introduced into the upper air passages, a serious drawback to the experimental method should be mentioned, namely that the strains employed had been subjected to one or more subcultures on artificial media. Whether or not such passage materially altered the invasive power of the organisms is uncertain, but it constitutes a weak point in an experiment designed to imitate natural conditions. However, the general trend of the results

was so uniform that some significance must be attached to them. The outstanding fact seems to be that the "normal" intact mucous membranes of the upper air passages are not only impervious to the attack of certain pathogenic bacteria, but that these organisms also fail to colonize on such surfaces. In other words conditions are analogous to those which obtain on the intact skin surfaces. Apparently the ground must be prepared in some way before these organisms can produce disease. The acute exanthemata such as scarlet fever and measles seem clearly to involve an alteration of the mucous membranes and perhaps of the body in general which allows such bacterial invasion. The familiar streptococcic complications of these diseases may be mentioned. Influenza similarly promotes secondary bacterial invasion, and poisoning with certain arsenical compounds associated with hyperaemia of the respiratory mucosa seems to operate in a similar way. Finally local irritation of the respiratory tract such as occurs in "gas" poisoning allows secondary bacterial invasion, and there are doubtless numerous other less obvious disturbances which bring about the same result. One might speculate further whether any of the recognized pathogens which invade through the respiratory tract, such as pneumococcus, meningococcus, and the tubercle bacillus, are capable of primarily creating their own portal of entry without the coöperation of some other factor.

Much further detailed study is needed to elucidate these leads, but the general conclusion may be drawn that the upper air passages offer to organisms which are not members of the normal flora not a favorable but an extremely unfavorable environment, and that, unless a special set of circumstances favors them, they are speedily eliminated without producing disease.

CONCLUSIONS

1. The free surfaces of the normal intact mucous membranes of the upper air passages offer an unfavorable environment for the growth and colonization of certain organisms both of the pathogenic and non-pathogenic groups.

2. Experimental inoculation indicates that these surfaces when intact are impervious to invasion by organisms which under other conditions may produce disease.

3. Various bacteria inoculated upon these surfaces in large amounts are promptly disposed of mainly by mechanical means.

4. The question is raised if some preliminary "injury" is not essential to the initiation of diseases which clinically appear to be primary, such as pneumonia, meningitis, tuberculosis and others.

REFERENCES

(1) Stillman, E. G.: J. Exp. Med., 1916, xxiv, 651.
(2) Bloomfield, A. L.: Bull. Johns Hopkins Hosp., 1919, xxx, 317.
(3) Bloomfield, A. L.: Ibid., 1920, xxxi, 14.
(4) Bloomfield, A. L.: Ibid., 1920, xxxi, (in press).
(5) Bloomfield, A. L.: Ibid., 1920, xxxi, (in press).

TWENTY-FOUR YEARS' EXPERIENCE WITH THE SUBCUTANEOUS TUBERCULIN TEST

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The subcutaneous tuberculin test has gradually fallen into disuse. The reasons for this are no doubt the dread of the danger of the occasional severe reactions, the introduction of the cutaneous, intracutaneous and ophthalmic tests, and of the X-ray, and the more widely disseminated knowledge that a positive reaction may not mean tuberculous disease in the organ under consideration. In spite of these facts, the subcutaneous tuberculin test has been used at the Trudeau Sanatorium, off and on, for the last twenty-five years. At one time, about seventeen or eighteen years ago, this test was given to all patients who after careful repeated examinations showed no tubercle bacilli in the sputum. During this period one or two patients had a somewhat prolonged period of depression, with increase of symptoms, following a rather severe reaction. On the other hand, many patients felt much better after a sharp reaction and some so well that they desired to take tuberculin treatment. One of the authors has had two or three severe reactions (104°) to tuberculin, obtained from inhalation of the spray, and could verify that a feeling of well being followed the reactions. The introduction of skin and eye tests and the fact that following a reaction to a subcutaneous dose of tuberculin focal pulmonary reactions were unusual, and in a deep-seated focus not to be expected, cast doubt upon the value of the subcutaneous test. The danger from tuberculin lies in the fact that extensive pulmonary disease may yield few or no physical signs and yet respond very actively to tuberculin. This, however, rarely followed in our early work with the subcutaneous test, but, in any case, the X-ray study at once reveals to-day the presence of any deeply seated focus. Not only is this disclosed, but some hold that congestive changes about reacting foci can be detected and that we thus have an additional means of determining a focal pulmonary reaction. A cottony, hazy appearance about a previously sharply defined "dense" nodule during the reaction, which in several days disappears, does occur and can be

interpreted as a congestive process. It is well known that during a tuberculin reaction such conditions can occur.

In all, 324 patients were subjected to the test and 282 reacted and 42 failed to react.

In a typical reaction, usually ten to eighteen hours after the injection, the patient begins to feel feverish, has slight elevation of temperature and has malaise. The symptoms are rapidly aggravated and the patient is soon forced to go to bed, with pains in the head, back and legs. Oppression in the chest may occur and the tendency to cough and to expectorate increases. The temperature may rise to 103° and usually falls rather rapidly after eight to twelve hours by lysis. It may not rise over 100° and may persist for several days with rather severe symptoms. The pulse may reach 120 or over, and the urine increase in amount with slight traces of albumen or a diazo reaction. The day following the reaction the patient is a little weak but soon feels as well as, if not better than, usual. After the larger doses of tuberculin, the reaction must be characteristic or show focal changes before it can be termed positive.

The tuberculin used was Koch's old tuberculin, designated as O. T. All cases received as an initial injection 3/1[1] and subsequently at intervals of three days, some of the following doses until reaction occurred: 3/2, 3/5, 2/1, 2/2, 2/3, 2/4, 2/5, 2/6, 2/7, 2/8, 1/1. If 1/1 produced no reaction this dose was repeated and if there was still no reaction the case was designated as not reacting to the test.

1. Percentage reacting in each group. For the reason that the usual procedure was to give only the following doses: 3/1, 2/1, 2/3, 2/5, 1/1, 1/1, those cases reacting to doses between the above groups were classified as reacting in the higher group. Thus, those reacting to 3/2, 3/5 and 2/1 were classified as reacting to 2/1 and those reacting to 2/2 and 2/3 were grouped in the 2/3 group, etc. When classified thus, the following number and per cent reacted:

REACTING DOSE	NUMBER OF CASES GIVEN THE DOSE	PER CENT OF REACTIONS
3/1	324	2
3/2, 3/5, 2/1	318	41
2/2, 2/3	189	30
2/4, 2/5	133	51
2/6, 2/7, 2/8, 1/1	65	35

[1] 3/2 = 0.0002 cc.; 2/1 = 0.001 cc.; 1/1 = 0.01 cc., etc.

In all, 282 cases reacted to the test but 14 were not examined during or immediately after the reaction. Of the remaining 268 cases which were examined for focal reaction, 199 or 74 per cent showed no focal reaction, as determined by physical signs. There were no râles present at any time in 68 (34 per cent) of these 199 cases. In 80 cases (40 per cent) râles were present before and after the test, and at the time of discharge, usually several months later. In 37 cases (19 per cent) râles were present before the test but disappeared before the time of discharge. And in 14 cases (7 per cent) râles not present before and during the test were present at discharge. In the vast majority of cases the râles were fine râles which occurred most often in the upper half of the lung.

2. Physical signs increased during reaction. Physical signs were increased during the reaction in 48 (18 per cent) of the 258 cases examined. Of these, 6 cases (12.5 per cent) had no râles upon admission or upon discharge, but did have them during the reaction. So, also, in 6 (12.5 per cent) the râles, occurring during reaction, persisted until discharge. In 5 cases (10 per cent) râles, present upon admission and increased during the reaction, were absent at discharge. And in 31 (65 per cent) the râles, present upon admission, were increased during the test and present upon discharge.

3. Physical signs diminished during reaction. In 21 of the 268 cases, physical signs were diminished during the reaction (8 per cent). Of these 21 cases, 16 had râles on admission and also at discharge. The remaining 5 cases had râles on admission but not at discharge (24 per cent).

4. Tubercle bacilli in sputum during and after test. Five cases had a history of tubercle bacilli being found in the sputum previous to admission. The accuracy of these observations was questioned at Trudeau. Other cases had tubercle bacilli as follows:

PREVIOUS TO ADMISSION	BEFORE REACTION	IMMEDIATELY AFTER REACTION	MONTHS AFTER REACTION	PERSISTING MONTHS AFTERWARDS	NUMBER OF CASES	GAFFKY
1	1	0	2	0	1	vii
1	0	0	?	0	1	?
1	0	1	0	0	1	ii
0	1	0	0	0	1	i
0	0	0	0	0	1	iv
0	0	0	1	0	4	i, i, iii, v
0	0	0	2	0	1	iii
0	0	0	3	0	4	i, ii, ii, iii
0	0	0	4	0	2	ii, v
0	0	0	5	0	1	v
0	0	0	7	0	1	i

Thus there were 18 cases (6 per cent) in which tubercle bacilli were found in the sputum while at the sanatorium. In only two instances were these found immediately after the test and one of these cases supposedly had bacilli present previous to admission. It may be correctly said that the incidence of occurrence of positive sputum in these test cases is not greater than the incidence of positive sputum occurring in similar cases which have had no tuberculin subcutaneously and a previously consistently negative sputum. None of these cases failing to react to 1/1 had tubercle bacilli in their sputum while at the sanatorium. And in only one instance was there a history of tubercle bacilli being found previous to admission. Of the 18 cases having positive sputum at the sanatorium, 10 (56 per cent) occurred in the group showing no increase of physical signs during reaction. Five (27 per cent) showed increased and two (11 per cent) diminished physical signs during reaction, and one was not examined.

5. *Occurrence of hemoptysis.* Of the 282 cases reacting to tuberculin, 68 (24 per cent) had hemoptysis at some time. Of these 68 cases, 46 (67 per cent) showed no change in physical signs during reaction, 11 (16 per cent) an increase, and 7 (10 per cent) a diminution. Four cases were not examined. Of the 42 cases not reacting, 7 (17 per cent) had had hemoptysis at some time.

6. *Occurrence of pleurisy.* Of the 282 cases reacting, 141 (50 per cent) had no history of pleurisy. Dry pleurisy occurred in 129 (46 per cent), while wet pleurisy occurred in only 10 cases (4 per cent). The occurrence of pleurisy bore no relation to a focal reaction as determined by physical signs. Of the 42 cases not reacting to the test, 26 (61.5 per cent) had no pleurisy, 15 (38 per cent) had dry pleurisy, and 1 (0.5 per cent) had pleurisy with effusion. Of the 144 cases with a history of dry pleurisy, 129 (89 per cent) reacted and of the 11 cases with wet pleurisy 10 (91 per cent) reacted.

7. *Focal reactions determined by X-ray.* There were 41 cases reacting constitutionally that had X-rays taken within 24 hours of the onset of the reaction. In this group there were:

Tumor	1
Pleurisy only	1
Negative cases	9
Peribronchial cases	26
Parenchymatous cases	5

The case with tumor showed an extension of the lesion, whether because of the tuberculin or not is problematical. The pleuritic case showed no change. Seven of the negative cases showed no change, while two showed a questionable increase in the shadows. Of the 26 peribronchial cases, 18 showed no change, 5 a questionable increase, 2 a definite increase, and one a questionable clearing of the shadows. Of the 5 parenchymatous lesions, 4 showed no change and one a definite increase in the shadows. Thus, of all cases considered, only 3 showed a definite increase in shadows during the reaction. Two of these were of the peribronchial and one of the parenchymatous type.

8. Post-discharge history. The following table compares the post-discharge history of the cases in year groups, according to the number of years after discharge that information is obtainable:

Post-discharge history

	AFTER 1 YEAR			AFTER 2 YEARS			AFTER 3 YEARS			AFTER 4 YEARS			AFTER 5 YEARS		
	Alive	Relapsed	Died	Alive	Relapsed	Died	Alive	Relapsed	Died	Alive	Relapsed	Died	Alive	Relapsed	Died
Reacting cases	280	12 (4%)	2 (7%)	249	16 (6%)	0	247	29 (11%)	2 (8%)	234	36 (15%)	5 (2%) Tb. 3 ? 2	225	41 (18%)	9 (4%) Tb. 6 Carc. 1 ? 2
Non-reacting cases	42	1 (2%)	0	28	2 (7%)	0	24	2 (8%)	1 (4%) Pneu.	20	2 (10%)	1 (5%) Pneu.	15	2 (12%)	2 (12%) Pneu. 1, ? 1

From the above, it is seen that the cases reacting to the test have a relapse incidence of $1\frac{1}{2}$ to 2 times the relapse incidence of those cases not reacting. However, the number of cases not reacting is too small from which to draw absolute conclusions.

9. Relation between focal reaction as determined by physical signs and X-ray findings. There were 41 cases that had X-rays made during the reaction, of which 4 had no chest examination made at the time. Of the remaining 37 cases, 29 showed no change in physical signs during the reaction. Of these 29, 22 had no râles. Of the 22 cases having no râles and showing no change in physical signs during the reaction, the X-ray showed no change in 15 (68 per cent). In 2 (9 per cent) an in-

crease, in 4 (18 per cent) a questionable increase, and in 1 (6 per cent) a diminution of shadows was seen.

Seven cases (5 with fine and 2 with moderately coarse râles) showed no change in physical signs during the reaction. Of these, the X-ray showed no change in 5 cases, a questionable increase in one case and an increase in one case. Two cases, both without râles upon admission, had questionable fine râles during the reaction. One showed no change, and the other a questionable increase in shadows by X-ray during the reaction. One case developed moderately coarse râles at a base during the reaction. This case showed a questionable increase of shadows by X-ray.

Three cases had a definite increase in râles during the reaction. All showed no change by X-ray. Two cases showed a diminution of râles during the reaction. Both showed no change by X-ray.

Of the 41 cases having X-rays before and during the reaction, 30 showed no change (73 per cent). Of the remaining 12, 7 showed a questionable increase (17 per cent), 3 a definite increase (7 per cent), and 1 a questionable clearing.

There seemed to be no difference in the after history of those who did and did not show focal reaction by means of X-ray. But the numbers are too few to warrant a definite statement.

10. Dangers of the test. When the cases are properly selected, the evidence is overwhelmingly in favor of no permanent harm being done, if the test is carried out carefully and the doses properly regulated and spaced. As a matter of fact, some cases seem to show improvement.

11. Selection of cases. It is obvious that the tuberculin is of no value when a diagnosis can be made with certainty without the test. Therefore, when tubercle bacilli are present in the sputum, or when there is a definite and otherwise unexplainable hemoptysis, or when definite moderately coarse râles are present in the upper half of the chest, or when there is a history of an otherwise unexplainable pleurisy with effusion, and when any one of the above is accompanied by a definite parenchymatous lesion as seen in the X-ray plate, somewhere in the upper half of the chest, the test should not be employed, as no further assistance can be given by it.

However, when the X-ray fails to show a definite parenchymatous lesion somewhere in the upper half of the chest and tubercle bacilli cannot be demonstrated, the test can be used advantageously as an aid in differential diagnosis, for, when the test proves negative, recent pulmonary tuberculosis is in all probability not present.

12. Value of the tuberculin test as regards diagnosis and treatment. Supposedly specific, the tuberculin test presupposes at least an infection with the tubercle bacillus when positive. However, it does not give any accurate information as to whether tuberculous disease is present or not: or, if present, the test does not give any definite knowledge regarding its activity. For this reason, therefore, a positive reaction must in itself mean nothing more than infection with the tubercle bacillus. However, when the reaction is accompanied by a definite focal pulmonary reaction as seen by the X-ray it must be supposed that the pulmonary infection at least is present. For this reason it is probably the wiser course to give the patient the benefit of sanatorium treatment, according to his symptomatic needs, for from three to six months in order that he might learn how to regulate his life properly and to avoid a future breakdown.

The 3 cases showing a definite pulmonary focal reaction by X-ray had no increase of physical signs during the reaction. Of the five cases showing by X-ray a questionable focal pulmonary reaction, only one had increase of physical signs during the reaction. It may be said that 73 per cent of the 41 cases having X-rays during the reaction showed no change by X-ray, and 78 per cent of 37 cases having both a chest examination and an X-ray during the reaction showed no change as determined by râles. So it can be truthfully stated that with a proper selection of cases the vast majority show no pulmonary change during the reaction. Of 267 cases examined during reaction, only 47 (18 per cent) showed an increase of râles or the occurrence of râles during reaction, and 21 (8 per cent) showed a decrease in râles.

When the test is negative, tuberculous infection is not proved or disproved, and the after history of patients shows fewer relapses from tuberculosis than if the test proves positive. So, also, in 42 cases not reacting, none were known to have died of pulmonary tuberculosis. In regard to two relapses, one occurred in an incipient case who had hemorrhages at the sanatorium and of whom no X-ray was made. This patient was alive eleven years after discharge. The other relapse occurred in a case otherwise negative and was classified as relapsed owing to the fact that hemorrhages occurred during the first and fourth years after discharge. So, if 42 cases can be used as a standard for judgment, a negative reaction in selected cases is so infrequently followed by relapse as to be fairly negligible. For this reason it can also be stated that a negative reaction presupposes symptoms of activity due to causes other than pulmonary tuberculosis.

SUMMARY AND CONCLUSIONS

1. These conclusions are based on a study of 324 patients subjected to the subcutaneous tuberculin test during a period of twenty-four years.

2. Added knowledge has restricted the use of this test to patients without a definite parenchymatous X-ray pulmonary lesion, or in rare instances to those with an apparently healed parenchymatous pulmonary lesion, slight in extent.

3. Forty-two patients failed to react to a second dose of 0.01 cc., O. T. (usually spoken of as 10 mg.).

4. Patients who fail to react to this dose may be safely returned home and to work.

5. The use of the subcutaneous tuberculin test has produced no lasting untoward result and, given as advised, has only a very temporary effect upon the patient, which, however, is more usually favorable.

6. In only 2 instances did tubercle bacilli occur in the sputum for the first time immediately after the test.

7. Over 90 per cent of the 75 patients with a history of hemoptysis reacted to the tuberculin test.

8. About 90 per cent of 144 patients with dry pleurisy, and 90 per cent of ten patients with wet pleurisy, reacted positively to the tuberculin test.

9. Of 41 patients studied by X-ray, only 3 showed a positive increase of shadows.

10. Of 268 patients, only 48 (18 per cent) showed an increase of râles during the reaction, and 21 (8 per cent) a decrease.

11. The subcutaneous tuberculin test when positive proves tuberculous infection, but when accompanied by definite clinical changes, or more surely if by increase of X-ray changes (focal reaction), indicates that the lesion is more accessible to circulatory changes and presumably less firmly cicatrized (healed).

THE RELATIONSHIP OF INFLUENZA TO CLINICAL PULMONARY TUBERCULOSIS

DEDUCTIONS FROM THE EPIDEMIC OF 1918–1919

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Impressed by the uniformity of histories associated with a similarity of clinical findings in an unusually large number of individuals coming to his attention in private, dispensary and sanatorium practice in Baltimore in the winter of 1918 and the spring of 1919, the writer was led to establish to his own satisfaction the influence of acute epidemic influenza on dormant and insidious tuberculosis. The particular study was not original, as the literature contains numerous observations of keen clinicians in similar epidemics of the past century; neither were the final deductions unique. Dr. Benjamin Rush writing in Medical Inquiries and Observations about influenza in Philadelphia in the autumn of 1789 and the spring of 1790 says, "It proved fatal to persons who had been previously debilitated by consumptive habits. It terminated in asthma in three cases coming under my notice and in pulmonary consumption in many more." Rush based this unequivocal deduction on physical findings and histories alone, as diagnostic methods of finesse, such as bacilli in the sputum and X-ray plates, were then unknown. Dr. Daniel Drake in his Systematic Treatise of the Principal Diseases of the Interior Valley of North America, writing about the sequelae of influenza, mentioned the unusual number of cases of pulmonary phthisis that developed (1). Drake was an army surgeon and was giving his experience in an outpost in the Ohio Valley in 1818. Dr. E. R. Baldwin, in Osler's Modern Medicine, writes, "Influenza must be classed as an important exciting cause, if not a true predisposition, of tuberculosis." Dr. W. G. MacCallum in his Text Book on Pathology says, "an existing tuberculous infection is rendered worse and new tuberculosis may arise on the basis of the influenza."

The literature also testifies to the importance of epidemic influenza as an etiological factor in numerous other acute and chronic diseases of

the lungs, as bronchopneumonia, fibrinous and serous pleurisy, empyema, lung abscess, chronic bronchitis, bronchial asthma, and bronchiectasis. Frothingham reports a case of double pneumothorax and another of suppurative pleurisy that came to his service at Camp Devens in 1918. Practically all these but the last two were encountered in this study, but neither the title of the paper nor the time will permit a discussion of the different ways, except one, in which influenza left its imprint in the chest, or of the relative frequency of its sequelae.

The first point established in this study was the presence of active pulmonary tuberculosis. The usual diagnostic methods of physical and sputum examinations, and sometimes X-ray plates were employed.

The real problem was the diagnosis of tuberculosis from the nontuberculous sequelae, the most difficult of which were residual pneumonia and bronchiectasis respectively. As a matter of fact, a major impression resulting from this investigation is that, in this connection, the tuberculous lesion is in most cases a graft upon a residual bronchopneumonia. Digression at this point is apropos. Students of tuberculosis generally agree that every individual who reaches the age of fifteen years has been infected by living tubercle bacilli, and that every adult human represents a victory of the species over the lower form of life. Thousands of infants and children die annually from one of the different forms of tuberculosis during an early attack of the microörganism without the true nature of the cause ever being diagnosed. By reason of early acquired immunity, most of us are able to encapsulate infecting tubercle bacilli and to pass through the remaining ages of life without further inconvenience. The encapsulated bacilli remain dormant until such a time as the body resistance to their further encroachment be broken down. This is not entirely accomplished by the action of the bacilli per se, but by such extraneous factors as intemperance, poverty, physical exertion and acute devitalizing diseases. The evolution of a massive influenzal infection into an acute tuberculous pneumonia, lies in the province of the pathologist, and its description cannot be undertaken here. Krause (2) in his essay The Nature of Resistance to Tuberculosis describes the fixed tissue capsule of the tubercle as an early established mechanical barrier between the imbedded bacilli and the body. As long as the barrier remains competent and prevents the passage of the bacilli to the outside, or the body fluids to the inside, there is complete isolation and no clinical tuberculosis develops. Local congestion of the surrounding tissues, however, breaks the competency of the capsule,

permitting the establishment of a "circulatory give and take." The adjacent tissues become seeded with virile bacilli and active tuberculosis may begin. In the local congestion of the pneumonia complicating influenza, we would seem to have the necessary outside factor for establishing Krause's "circulatory give and take."

This being true, the physical signs of the pneumonia and resulting tuberculosis would differ only with the stages of development. A bronchopneumonia that had not undergone evolution would not demonstrate the same degree of dulness, voice and breath sounds, and the showers of large moist râles which the same lesion would show later in the stage of ulceration.

On physical examination the lesions that proved to be only residual pneumonias, clearing up after a period of observation, were unilateral, being located more often in a lower lobe and usually in the left lung. One which cleared completely in six months was located at a point corresponding to the spine of the left scapula. Diffusely scattered râles were heard in the opposite lung unaccompanied by a localized area of intense whispered voice and breath sounds.

The lesions which subsequently proved to be tubercle were bilateral, more extensive and located at the roots of the lungs. The lesion in the right was usually the larger and although it frequently extended downward and outward toward the base, the apex as a rule was apparently clear. The signs of maximum intensity were in the upper interscapular area. The lesion in the left was usually smaller and the signs less pronounced.

In spite of the definite findings of physical examination, however, the examiner was unwilling to make a definite diagnosis in several cases until after a period of observation and a series of sputum examinations. In regard to sputum examinations, the tubercle bacilli were frequently absent in the early stage before softening began and their absence often confused what was considered at the time an accurate diagnosis. The late appearance of the bacilli was misleading, especially to general practitioners, and often resulted in a loss of time and consequent progress of the disease.

The X-ray picture was interesting. A composite plate of the tuberculous lesions would show: In the right, an extensive homogeneous mass at the hilum with a pedunculated extension downward and outward toward the base and another toward the periphery. The margin of this mass was fuzzy or had the thickly studded appearance of a miliary

lesion. There was a clearer area in the upper part of the mass with a more or less defined margin. The apex was clear or contained chronic tuberculous markings of no consequence. The left would have a similar but smaller mass at the root. Calcified glands showed in both lungs. A composite plate of the pneumonia cases would show a less dense shadow with poorly defined borders dissociated with the root, at a point corresponding to the inferior angle of the scapula. Bronchial shadows extending toward the base were well defined in both lungs. Features of both these composite plates were sometimes associated.

The next point determined was the fact of influenza among those in whom active pulmonary tuberculosis was diagnosed. Many gave an indisputable history of epidemic disease. A number knew they had tuberculosis prior to the acute illness. Others gave a history of symptoms which showed undoubtedly that they must have had active tuberculosis prior to the acute influenza, while others denied emphatically any illness whatever that could have been construed as tuberculosis. Influenza was not given the benefit of having been present in any doubtful history. Unless the individual could give rather clearly a history of a definite attack of acute exhausting illness of the respiratory system occurring in the period of the epidemic, influenza was not considered as a factor in his physical condition. Even a "bad cold" was regarded with askance and usually disregarded.

As it was impossible, through a lack of facilities, to analyze the 500 dispensary, sanatorium and office patients seen during the year following the appearance of the epidemic in September, 1918, the patients admitted to Eudowood Sanatorium are utilized to determine the conclusions of this investigation. Practically all these patients were seen by the writer prior to admission, and were admitted because of active tuberculosis, and without regard to, or knowledge of, the exciting etiological factor in most instances.

Of the 188 bona fide cases of tuberculosis admitted, 53 or 28 per cent gave a history of having had influenza during the epidemic; 9 or 17 per cent of the 53 had known tuberculosis prior to influenza; 14 or 26 per cent gave a history strongly suspicious of a previous attack of tuberculosis, but no diagnosis had been made; 30 or 56 per cent of the influenza cases or 16 per cent of the 188 denied any previous illness that could have been construed as tuberculosis. The average duration of the acute illness was three weeks and the average interim before diagnosis of tuberculosis was made was four and a half months. The line of separation

of the acute illness and the onset of tuberculosis was not apparent in many instances, but in most cases there was a definite lull of symptoms before the redevelopment of sufficient illness to take the patient to a physician. The element of diagnostic error in these patients was reduced by the presence of bacilli in the sputum of 39 of the 53 and by confirmation of physical findings with the X-ray in 9 others, leaving 5 as a rather narrow margin for error. The condition of the 53 on April 1 last was as follows: Of the 9 who were known to have had tuberculosis 3 are classed as dead, 3 unfavorable and 3 favorable; of the 14 who had had symptoms indicating a previous attack of tuberculosis, 5 are dead, 3 unfavorable, 5 favorable and 1 unknown; of the 30 who had no previous history, 7 are dead, 11 unfavorable, 7 favorable, 3 doubtful and 2 unknown. To summarize, 15 are dead, 17 unfavorable, 16 favorable, 2 doubtful and 3 are unknown.

According to the American Public Health Association Reports the influenza morbidity of the national population of 100,000,000 was 10,000,000 or 10 per cent, with a mortality of about 500,000 or one-half of 1 per cent. In Maryland, with a population of 1,300,000 there were 150,000 cases or approximately 10 per cent, with an immediate mortality from all complications of 6375 or approximately one-half of 1 per cent. The influenza statistics of the nation and this state are so closely parallel that the writer, curious to see whether the same similarity existed regarding the influence of the acute illness on tuberculosis, sent a questionnaire to ninety representative sanatoriums of the different states of the Union. The following is the questionnaire and the summary of answers received from 29 sanatoriums that were good enough to reply, and the figures of which were available:

1. Number of bona fide cases of pulmonary tuberculosis admitted from October 1, 1918, to October 1, 1919........................7871 or 100 per cent
2. How many patients gave history of having had definite influenza during the recent epidemic?..................................2143 or 27 per cent
3. How many of these knew they had tuberculosis prior to their attack of influenza?..482 or 22.4 per cent
4. How many who had influenza gave a history of chest symptoms prior to the influenza that you believe were due to active tuberculosis, though a diagnosis had not been made?..........................507 or 23.7 per cent
5. How many who had influenza were perfectly free according to the history from any known clinical tuberculosis prior to the epidemic?
   1150 or 54 per cent of the post-influenza cases or 15 per cent of all admitted
6. What are the present classifications of your post-influenza tuberculosis cases?
   Answer: Majority moderately advanced.

7. What are the present prognoses of these cases? Answer: On the whole, unfavorable.
8. Have you recovered tubercle bacilli from the sputum of all of them? Answer: 1409 positive; 746 negative.
9. In your experience, has the epidemic increased the number of cases of tuberculosis requiring sanatorium treatment in your section of the country? 23 answered yes, 2 slightly, 2 no and 2 were undecided.

Curiously, 5 of the institutions that were dubious or had not experienced an increase were in New York and Pennsylvania. The Montefiore Home had experienced no increase and the National Jewish Sanatorium, Denver, reported a slight increase.

The fact that 29 representative and widely scattered sanatoriums admitted 7871 patients, 1170 or 15 per cent of whom disclaimed any sickness prior to the attack of influenza to which they personally attributed without successful controversion the beginning of their serious illness, would seem to place influenza, in epidemic form at any rate, in the front rank of the exciting causes of clinical tuberculosis.

We have no definite way of determining what percentage of the actively tuberculous apply for sanatorium treatment, but very likely the number maintains a constant ratio to the whole; and the conclusion does not seem illogical that if 15 per cent of the sanatorium population could blame influenza for their incapacity, 15 per cent of the whole tuberculosis population could do likewise.

Besides being of itself a devastating illness, influenza assumes a special significance when a large number of cases of tuberculosis can be directly attributed to it, and every known means to exterminate it must be employed.

Patients are still coming for diagnosis with a history pointing definitely to an attack of influenza during the first wave of the epidemic in 1918. A diagnosis should have been made at least a year ago; and that it was not can be attributed in many instances to a failure to recover tubercle bacilli from the sputum in the early weeks of the illness. I strongly approve of this Association's programme for the examination of every individual giving a history of epidemic influenza, especially those who have never fully recovered, and trust that nothing will intervene to prevent its consummation.

REFERENCES

(1) Quoted from Guy Hinsdale's Epidemics of Influenza in 1647, 1789–1790, and 1807.
(2) Krause, A. K.: The nature of resistance to tuberculosis, Amer. Rev. Tuberc., 1917, i, 65.

Tabulated replies from 29 sanatoria to questionnaires asking for data concerning the incidence and influence of influenza in tuberculosis

NAME	CASES ADMITTED OCTOBER 1, 1918 TO SEPTEMBER 30, 1919	HISTORY OF INFLUENZA	KNOWN TUBERCULOSIS PRIOR TO INFLUENZA	TUBERCULOSIS SYMPTOMS WITHOUT DIAGNOSIS PRIOR TO INFLUENZA	TUBERCULOSIS BEGINNING WITH INFLUENZA	HAS INFLUENZA INCREASED NUMBER CASES OF TUBERCULOSIS?
Pottenger, Monrovia, Cal	169	50	18	12	20	Yes
Maryland State	837	330	11	122	197	Yes
Gaylord Farm, Wallingford, Conn	164	67	13	18	36	Yes
Warrensville, Ohio	401	116	16	20	80	Yes
New Mexico Cottage	114	39	11	0	28	Yes
Chicago-Winfield	163	54	6	20	28	Yes
Metropolitan Life, Mt.McGregor, N. Y	175	92	15	27	50	Yes
Woodlawn, Dallas	21	14	6	0	8	Yes
Bon Air, Bradford, Pa	63	17	6	6	5	Slight
Montefiore Home, N. Y	360	44	22	15	7	No
Washington Municipal	277	51	23	0	28	Yes
Kansas State	84	27	0	15	12	Yes
New Hampshire State	98	41	14	10	17	Yes
Central Maine	322	130	15	12	103	Yes
Michigan State	180	91	23	3	65	Yes
National Jewish, Denver	187	26	15	0	11	Slight
Muirdale, Wisconsin	558	88	33	0	55	Yes
Winyah, Asheville	133	60	9	12	39	Yes
Iola, Rochester, N. Y	335	84	0	33	51	Yes
Agnes Memorial, Denver	214	85	32	0	53	Yes
Edgewood, Del	44	6	0	0	6	Yes
Ohio State	253	59	16	21	22	Yes
Otisville, N. Y	927	106	41	24	37	?
Mt. Alto, Pa	725	142	45	36	61	No
Loomis, N. Y	199	47	18	16	13	Yes
North Carolina State	332	108	22	39	47	Yes
New Jersey State	191	61	14	19	28	Yes
Stony Wold, N. Y	157	55	31	11	13	Yes
Eudowood, Md	188	53	7	16	30	Yes
Totals	7,871	2,143	482	507	1,150	

THE EFFECT OF HEAT ON EXPERIMENTAL TUBERCULOSIS

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There have been numerous attempts to correlate increased resistance to tuberculosis and lymphocytosis (1) but most of the earlier experiments were not of a conclusive nature. The reason for this belief in the action of the lymphocytes (or mononuclear cells) in tuberculosis was probably based on the coincident pathological fact that the mononuclear cells or lymphocytes are so intimately associated with tubercle formation, and it was therefore reasoned that their increase certainly should be associated with an increased resistance to the disease. With the advent and general use of the roentgen ray and a realization of its leucopenic action further evidence could be accumulated incriminating the lymphocyte. By means of the X-ray Murphy and Ellis (2) believed that they were able to decrease the resistance of white mice to bovine tuberculosis. They, however, used as a gauge of the diminished resistance the duration of life of the animals, a criterion which is open to criticism, especially considering that large doses of bovine tubercle bacilli were used for infecting, and that consequently two toxic substances—tubercle bacilli and roentgen ray—would kill earlier than either alone. On the basis of this work Morton (3), a co-worker of Murphy, devised a method for hastening the guinea pig diagnosis for human tuberculosis, and found that a single massive exposure of the animal to the X-ray, shortly before or after infection and sufficient to produce a temporary leucopenia, would so lower the resistance of the animals that a diagnosis was possible within eight to ten days as contrasted to the usually required five to seven weeks. His technique was, however, faulty in not recognizing that tubercle bacilli were distributed unevenly in the tuberculous urine used for infection. Corroboration of this work has not been possible by either Kellert (4) or Corper (5) the latter using an exhaustive technique and, in addition to the X-ray, benzol, and thorium X, both capable of producing a marked leucopenia.

Murphy and Sturm (6), further pursuing their studies of the lymphocyte, have found that animals subjected to dry heat (fifteen minutes at 45° to 50°C. for guinea pigs and five minutes at 55° to 65°C. for mice and rats) for a short period of time showed a sharp fall in the total white blood count, both the polymorphonuclear leucocytes and lymphocytes taking part in the fall. Following this, there is a slow recovery on the part of the polymorphonuclear leucocytes which generally require several weeks to regain their normal number. The lymphocytes rise rapidly after the initial fall and continue to rise for two or three weeks. This increase often amounts to a gain of over 200 to 300 per cent above the normal count for the animal (observation on only one guinea pig is recorded). The circulating lymphocytes during the more active stage of stimulation after heating show numerous examples of amitotic division. With this new method of stimulating the lymphocytes, Murphy and Sturm (7) tested the effect of heat upon the resistance of mice to bovine tuberculosis using 2 mgm. for infecting and again measuring the resistance to the disease by the duration of life of the experimental animals. They found this resistance, judged by the time of survival after inoculation, to be increased from two to threefold. The average length of life after inoculation for three groups of heated mice was 88, 69 and 67 days respectively, while the control groups averaged 16, 29, and 28 days respectively.

In view of the importance of these investigations, especially to workers in the field of tuberculosis, it seemed desirable to extend this study to other animals. We have attempted to study the effect of heat upon experimental tuberculosis in the guinea pig infected with human tubercle bacilli and using as criterion the anatomic distribution of the tuberculosis rather than the death of the animal.

We agree with Marmorek (8) who observes that death of the animal is of minor significance, and Krause (9) who points out the importance of accident in determining the issue. For this purpose two sets of experiments were performed which differed mainly in the use of two different cultures (strain 1687 and strain Obershaw) of virulent human tubercle bacilli. Each set comprised 24 guinea pigs, 12 being infected by the subcutaneous injection of 0.000,01 mgm. and the other 12 receiving 0.000,000,1 mgm. of tubercle bacilli. Of each 12 guinea pigs infected with the same dose of tubercle bacilli, 4 were kept as controls and received no treatment, while the remaining 8 were heated for fifteen minutes to 50°C. in a specially constructed glass walled box through which con-

TABLE 1

The effect of heating upon experimental tuberculosis (culture no. 1687) in the guinea pig

CULTURE OF HUMAN TUBERCLE BACILLI	AMOUNT USED FOR INFECTING	TREATMENT	NUMBER OF GUINEA PIG	RESULT OBTAINED FORTY DAYS AFTER INFECTION (FORTY-FIVE DAYS AFTER HEAT TREATMENT)	WHITE COUNTS: Per cent polymorphonuclears: Before	Per cent polymorphonuclears: After heating: 4 days	8 days	12 days	Per cent lymphocytes: Before	Per cent lymphocytes: After heating: 4 days	8 days	12 days	Total white* counts: Before	Total white* counts: After heating: 4 days	8 days	12 days
	mgm.															
No. 1687	0.000,01	Controls	1	++	20	54	70	50	79	46	30	50	13.1	13.2	12.3	16.6
			2	+++	30	57	65	39	69	42	35	61	12.3	15.4	17.4	19.6
			3	+++	29	65	67	52	70	34	33	48	15.7	12.2	16.4	14.8
		Heated 15 minutes at 50°C.	5	+++	29	67	46	40	71	33	54	59	11.6	11.2	5.6	13.4
			6	++	42	71		56	57	28		44	9.8	9.2	7.6	8.4
			7	+++	8	43	16	12	92	57	83	88	12.8	10.4	18.2	13.0
			9	+++	26	46	43	62	72	52	55	38	12.1	8.0	9.6	17.2
			10	+++	24	75	50	75	76	23	50	25	11.7	10.0	10.4	15.0
			11	+++	16	56	38	56	84	44	62	44	6.6	9.2	7.0	8.4
			12	+++	16	27	58	20	83	70	41	80	8.4	13.0	9.0	16.0
No. 1687	0.000,000,1	Controls	13	++	37	28	44	31	63	72	54	68	11.6	7.6	15.6	8.8
			14	+++	36	52	53	45	64	48	47	55	9.1	10.2	15.6	13.6
			15	++	33	66	56	38	66	34	44	62	12.5	9.6	12.6	7.6
			16	++	17	50	50	24	83	50	48	76	15.3	18.4	12.4	15.0
		Heated 15 minutes at 50°C.	17	++	32	47	49	52	68	52	51	47	6.7	18.8	19.2	12.8
			18	+++	36	71	39	8	64	29	60	92	10.4	17.0	14.4	12.0
			19	+++	40	51	56	50	60	47	43	49	10.5	12.2	11.6	13.6
			20	++	44	65	43	35	53	35	57	64	5.8	12.8	8.0	6.6
			21	++	21	57	29	43	78	42	69	57	7.6	8.6	9.6	13.0
			22	++	24	67	20	34	74	31	80	66	7.6	16.0	8.0	10.8
			23	++	54	38	52	33	45	59*	48	67	23.0	12.8	15.2	17.0

* The decimal indicates thousands per cubic millimeter of blood, i.e., 8.6 = 8,600 white cells per cmm. blood.

\+ = Distinctly enlarged local and slightly enlarged retroperitoneal glands. ++ = Enlarged local and retroperitoneal glands and slight involvement of the spleen. +++ = Enlarged local and retroperitoneal glands, spleen markedly involved, the peritracheal glands enlarged and the lungs slightly involved. ++++ = Massive involvement of all the glands, spleen, lungs and liver.

TABLE 2

The effect of heating upon experimental tuberculosis (culture Obershaw) in the guinea pig

Culture of human tubercle bacilli	Amount used for infecting	Treatment	Number of guinea pig	Result obtained forty days after infection (forty-five days after heat treatment)	White counts: Per cent polymorphonuclears, Before	Per cent polymorphonuclears, After heating, 4 days	8 days	12 days	Per cent lymphocytes, Before	Per cent lymphocytes, After heating, 4 days	8 days	12 days	Total white* counts, Before	Total white* counts, After heating, 4 days	8 days	12 days
	mgm.															
Obershaw	0.000,01	Controls	25	+++	9	18	33	43	91	82	67	56	10.0	8.6	9.6	20.8
			26	+++	30	65	63	30	70	35	37	70	10.4	12.8	8.0	10.0
			27	+++	62	52	44	51	38	48	55	48	12.6	10.8	9.2	10.0
		Heated 15 minutes at 50°C.	29	+++	46	68	40	33	53	32	60	67	10.4	8.2	12.4	16.4
			30	++	50	57	36	47	50	40	64	53	15.2	14.2	13.2	23.6
			31	+++	58	47	52	51	40	52	48	48	7.0	10.8	8.8	22.8
			32	+++	45	20	62	35	55	79	38	64	9.0	9.8	12.8	14.0
			33	+++	14	9	12	45	86	90	88	55	14.8	12.8	12.4	15.6
			34	+++	52	35	59	26	48	63	41	70	12.4	16.0	13.6	9.0
			35	++	22	20	52	26	78	79	48	71	12.0	9.8	15.6	14.8
			36	+++	26	28	66	72	70	72	33	27	14.8	15.2	14.4	17.2
Obershaw	0.000,000,1	Controls	38	++	50	58	51	55	49	42	49	45	9.8	15.2	12.8	14.4
			39	++	37	30	47	51	60	70	53	48	10.4	16.6	20.8	18.8
		Heated 15 minutes at 50°C.	41	+++	20	35	53	38	80	62	47	60	18.4	12.8	13.2	10.0
			42	++	56	54	63	80	43	45	37	20	14.4	12.6	9.6	12.0
			43	+++	42	29	32	57	57	70	68	40	13.8	8.8	14.4	9.2
			44	++	25	56	60	55	74	43	39	43	18.4	21.8	15.2	10.4
			45	++	47	28	35	37	53	72	65	62	11.2	14.6	10.8	16.4
			46	+++	33	22	5	12	67	75	95	86	4.8	8.8	7.2	6.2
			47	++	40	48	60	47	59	50	40	50	12.2	10.4	9.6	15.0

* The decimal indicates thousands per cubic millimeter of blood, i.e., 8.6 = 8,600 white cells per cmm. blood.

\+ = Distinctly enlarged local and slightly enlarged retroperitoneal glands. ++ = Enlarged local and retroperitoneal glands and slight involvement of the spleen. +++ = Enlarged local and retroperitoneal glands, spleen markedly involved, the peritracheal glands enlarged and the lungs slightly involved. ++++ = Massive involvement of all the glands, spleen, lungs and liver.

tinual observations could be made. They were heated by means of an electric hot plate, sufficiently separated from the animals and capable of maintaining a temperature of practically 50°C. in the compartment containing the animals throughout the period of heating, the temperature being regulated by an accurate thermometer in the animal chamber. The heating chamber was also sufficiently ventilated to take care of the

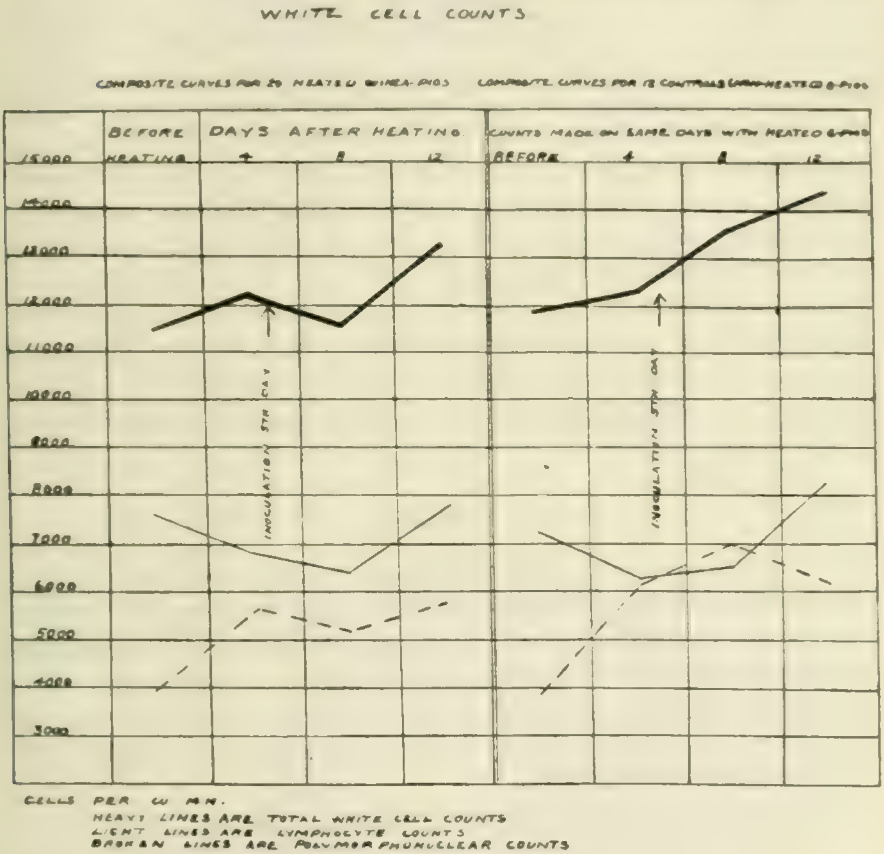

CHART 1

air need of the animals. After fifteen minutes' heating to 50° the guinea pigs revealed marked prostration and a reaction from which they recovered about five to ten minutes after removal from the heating chamber.

All the animals were inoculated five days after the treated animals had been heated—the time when the lymphocytes should be definitely increasing, according to Murphy and Sturm. Leucocyte counts were

made before heating and at four day intervals after heating for twelve days, the results of these counts being tabulated with the pathological findings in tables 1 and 2 and chart 1. After inoculation the animals were unmolested for forty days except to make the blood counts. Seven guinea pigs died during the period; four were heated animals, while three were controls. Of the animals that died the average length of life of the heated guinea pigs was twenty-three days; of the unheated, twenty-two days. We observe here no such marked difference as seen by Murphy and Sturm between their heated and control mice. As will be seen from chart 1, the leucocyte counts show nothing distinctive. In the heated animals there was a slight fall in the lymphocyte count followed by a slight rise, but this does not materially differ from that of the nonheated animals. A possible criticism here is that the blood counts were not extended over a longer period. After forty days all the guinea pigs were sectioned and the anatomical distribution of tuberculosis in each animal tabulated. As seen from tables 1 and 2 there is no marked difference between the heated and nonheated guinea pigs. No special study was made of the atypical cells found in the blood smears, since the main object of this work was to determine the effect of external heat on guinea pigs inoculated with virulent human tubercle bacilli.

SUMMARY

1. Guinea pigs were heated for fifteen minutes at 50°C. according to the directions given by Murphy and Sturm for increasing the lymphocytes in the circulating blood. Five days later, when the lymphocytes are supposedly increasing, these animals were inoculated with small doses of virulent human tubercle bacilli.

2. Blood counts were made before heating and at four day intervals after heating for twelve days.

3. All the animals were sectioned forty days after inoculation.

4. Comparing the heated and nonheated animals, there was no distinctive difference in the anatomical distribution of the tuberculosis, there was no distinctive difference in the blood counts of the two groups, and in the animals that died there was no difference in their duration of life.

REFERENCES

(1) A good summary of the early literature and experimental evidence is given by WEBB, G. B., AND WILLIAMS, W. W.: Trans. Nat. Assoc. Study and Prev. Tuberc., 5th Annual Meeting, 1909, 231, and 6th Annual Meeting, 1910, 279.

(2) MURPHY, J. B., AND ELLIS,, A. W. M.: Jour. Exp. Med., 1914, xx, 397.

(3) MORTON J. J.: Ibid., 1916, xxiv, 419.

(4) KELLERT, E.: Jour. Med. Res., 1918, xxxix, 93.

(5) CORPER, H. J., Amer. Rev. Tuberc., 1918, ii, 587.

(6) MURPHY, J. B., AND STURM, E.: Jour. Exp. Med., 1919, xxix, 1.

(7) MURPHY, J. B., AND STURM, E.: Ibid., 1919, xxix, 35.

(8) MARMOREK, A.: Berl. klin. Wchnschr., 1906, xliii, 528.

(9) KRAUSE, A. K.: Amer. Rev. Tuberc., 1917, i, 65.

THE EFFECT OF BLEEDING UPON TUBERCULOSIS IN THE GUINEA PIG

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Resistance to tuberculosis or, in plainer terms, the factors that oppose the development and spread of tuberculosis in man, as it naturally occurs, and in animals, both naturally and as observed experimentally, is no doubt made up of a large number of factors, each individual one of which can only be discovered by careful segregated experimental study. It has been found within the past few years that doses of such leucotoxic agents as benzene (1), roentgen rays (2) and thorium X which, causing profound changes in the haematopoetic organs and a consequent marked leucopenia, had very little effect upon the spread of tuberculosis in guinea pigs experimentally infected with small doses of human tubercle bacilli. These same agents do, however, influence antibody formation (3) and markedly enhance streptococcus and pneumococcus infections (4). Likewise, the local effect of cantharides, capsicum, turpentine and croton oil, powerful chemical irritants, are without effect upon the subsequent spread of tuberculosis, while powdered glass has a marked local effect in that it favors the spread of the disease (5). The explanation of this action is unknown. Soot or charcoal has an inhibitory action locally which may be easily conceived as due to its inherent antiseptic properties, although a changed cellular reaction may have something to do with it (6). Even in the consideration of the effect of pulmonary hemorrhage upon natural pulmonary tuberculosis in man, there are no doubt a number of factors involved, as, for instance, the effect of the hemorrhage *per se* upon the individual generally, the effect of the accumulation of blood in the lungs consequent upon the pulmonary hemorrhage on the individual's resistance, and the effect of the hemorrhage, usually occurring from tuberculous focus, upon the subsequent spread of the disease to healthy lung tissue and other parts of the body. Numerous experimental studies upon resistance to tuberculosis have been presented but it is rather singular that no reports are to be found in the literature upon the effect of

hemorrhage or bleeding upon tuberculosis. It is obvious that from an experimental standpoint the only one of the above points mentioned that lends itself for experimental study with sufficient control to be of value is the effect of bleeding *per se* upon tuberculosis.

In a study of this kind it would, of course, be inadvisable to subject the animals to a procedure such as bleeding from the heart, which would be hazardous and result in a high mortality among them. Repeated bleedings from a vein have their drawbacks. To bleed from the ear repeatedly would also prove difficult under ordinary circumstances, so that recourse was had to a method frequently used by us in rabbits, that is, to shave the ear and after cleaning well with alcohol, to moisten it with xylol after which as much as from 1 to 5 cc. could be obtained at a single bleeding. Care, however, must be taken to remove all traces of xylol after bleeding by means of alcohol since this reagent produces a profound necrosis if left on the ear. The experiments to be reported consisted of 4 control guinea pigs, that were bled but not infected, to note the effect of the entire manipulation upon normal animals; and 48 infected animals, of which there were two sets of 24 each, infected with different cultures of virulent human tubercle bacilli, no. 1687 and no. 758; 12 of the latter receiving 0.000,01 mgm. of culture and the other 12 receiving 0.000,000,1 mgm. Of these 12 there were 4 guinea pigs, as controls, which were infected but not bled, 4 animals which were bled seven days before infection and every other day for twenty-eight days after infection and then every third day until sectioned, and 4 which were bled like the former but begun coincident with infection. The bleedings amounted to from 1 to $1\frac{1}{2}$ cc. at a time or to a total about 40 cc. to 50 cc. for a given guinea pig during the entire period of experiment. Crude Tallquist hemoglobin determinations were made at every bleeding and the readings ranged between 90 and 100 per cent hemoglobin throughout the entire experiment. The guinea pigs were all sectioned on the forty-first day after infection with the findings given in table 1. The controls which were bled but not infected revealed no abnormalities of interest.

An examination of the table reveals no consistent differences between the control guinea pigs which were infected only with small doses of virulent human tubercle bacilli and those bled on alternate days pactically throughout the entire period of infection, or even if bleeding were initiated a week before infection. This experiment would seem to indicate that even prolonged bleeding, in amounts insufficient to perceptibly influence the hemoglobin content of the blood, in itself has no marked in-

fluence upon the progress of the tuberculosis but it must not be forgotten that, from the standpoint of pulmonary tuberculosis in man especially, this deals only with part of a large and complicated problem.

TABLE 1

Effect of repeated bleeding on alternate days upon tuberculosis in the guinea pig

WHEN BLED	BLEEDING BEGUN		CULTURES OF HUMAN TUBERCLE BACILLI			
			No. 1687		No. 758	
			0.000,01 mgm.	0.000,000,1 mgm.	0.000,01 mgm.	0.000,000,1 mgm.
	Controls. Not bled	1	++*	+++	++	++
		2	Died	++	++	++
		3	Died	++	Died	++
		4	+++	Died	++	++
On alternate days until twenty-eight days after infection when animals were bled every third day until sectioned	Seven days before infection	5	++	++	++	++
		6	++	+	++	+
		7	+	++	+	++
		8	++	++	++	++
	Coincident with infection	9	+++	++	+++	++
		10	+++	Died	+++	+++
		11	++	++	Died	++
		12	+++	++	++	++

* The animals were killed 41 days after infection.

+ Distinctly enlarged local and slightly enlarged retroperitoneal glands.

++ Enlarged local and retroperitoneal glands and slight involvement of spleen.

+++ Enlarged local and retroperitoneal glands, spleen markedly involved, the peritracheal glands enlarged and the lungs slightly involved.

++++ Massive involvement of all glands, spleen, lungs and liver.

SUMMARY

Bleeding in amounts of from 1 to $1\frac{1}{2}$ cc. on alternate days, initiated a week before and continued practically throughout the entire period of infection (forty-one days), has no appreciable effect upon the tuberculosis produced by small doses of virulent human tubercle bacilli (0.000,01 and 0.000,000,1 mgm.) given subcutaneously to guinea pigs as measured by the anatomic tuberculous involvement.

REFERENCES

(1) Corper H. J.: Attempts to reduce the resistance of the guinea pig to tuberculosis by means of various agents. Amer. Rev. Tuberc., 1918, ii, 587.

(2) Kellert, E.: On the increased susceptibility of X-rayed guinea pigs to inoculation with tubercle bacilli. J. Med. Res., 1918, xxxix, 93.

(3) Hektoen, L., and Corper, H. J.: Effect of thorium X on antibody formation. Jour. Infect. Dis., 1920, xxvi, 330.

(4) Corper, H. J.: Effect of thorium X on pneumococcus and streptococcus experimental infections. To appear at a later date in the Journal of Infectious Diseases.

(5) Corper, H. J.: Further attempts to reduce the resistance of the guinea pig to tuberculosis. The effects of various local irritants. Amer. Rev. Tuberc., 1919, iii, 605.

(6) Mavrogordato, A.: Experiments on effects of dust inhalations. Jour. Hyg., 1918, xvii, 439.

AN ANOMALOUS POSITION OF THE COLON REVEALED DURING ROUTINE CHEST EXAMINATION

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The position of the intestines in the abdomen is rarely such as to lead to confusion in the diagnosis of chest conditions, but a few recorded instances merit consideration. Anomalous conditions of the intestines have led to extensive reports, both clinical and post mortem, dealing with simple misplacements, anomalous lengths of various parts and shortening or complete absence of certain parts of the small and large intestines. Many of these conditions have for their basis embryological or developmental anomalies or certain pathological conditions occurring during the various stages of development. Anomalous positions, form and size of the large intestines have been well studied on postmortem material by Curschmann (1) who divides his studies into those involving the caecum and ascending colon, the transverse colon and the two flexures, and finally the descending colon and the sigmoid flexure.

Curschmann found anomalies of the transverse colon to be fairly common. In some cases the transverse colon can be much longer than normal and can be misplaced upward and will then encroach upon the entire anterior surface of the liver. He believes this condition to be either a congenital anomaly or at least a condition of long standing on account of the form impression made upon the surface of the liver by the colon and the thickened condition of the serosa in this vicinity with adherence in places. He states that almost every year he encountered at least one or more of these cases clinically and their findings remained constant for years. No noticeable clinical symptoms were produced in any of his cases by this condition. He gives two cases in detail upon which postmortem examination revealed the complete existing condition. The first case of which a sagittal section (picture) was given illustrates the relation between the liver, colon and diaphragm. The second case (not illustrated by him) was mistaken clinically for spontaneous pneumoperitoneum with a coincident peritonitis and was found at

autopsy to be a case of excessive length of the transverse colon encroaching above upon the liver and reaching the diaphragm, and in addition an excessive length of the sigmoid flexure. Curshmann also calls attention to the fact that these conditions of the colon may easily lead to mistaken diagnosis of liver conditions.

We have found in the literature only one other case in which the liver, colon and diaphragm were in close proximity. This was reported in 1903 by Horand (2) in very brief form. In it the liver revealed on its superior surface two definite impressions of the transverse colon. From the hepatic flexure situated under the liver, the colon extended upwards to the upper surface of the liver, encircling in its course the gall bladder, where it lay between the liver and diaphragm, being markedly compressed. It descended toward the left, resuming its normal course at the splenic flexure. The large intestine was doubled backward and on itself, lying between the diaphragm and liver. The gall bladder was also doubled back, downward and toward the median line. That the caecum may possibly also attain this abnormal position is indicated by an autopsy reported by Barton (3) in which the ascending and transverse colon had such a long peritoneal attachment that the caecum could be put into any region of the abdomen.

Our instance of anomalous position of the colon was encountered during a routine hospital examination.

CASE REPORT

The patient, a male, thirty-six years old, a photoengraver by occupation, was admitted to the hospital December 19, 1919. He gave a previous history of having had measles in childhood and pneumonia in 1904, his family history containing nothing of importance. His present illness began in 1917 when he had a slight hemoptysis followed by cough and loss of weight. He gave no symptoms referable to the gastrointestinal and urinary tracts.

On physical examination, he did not appear to be acutely ill. He was a medium sized fairly well nourished person, his facies suggesting recent loss of weight, and he appeared to be slightly cyanotic. His eyes, ears, nose, mouth and neck were otherwise normal. The heart dulness was normal with the apex beat in the fifth interspace inside the nipple line, and the sounds normal. The pulse was full and regular, the rate 80 per minute. On percussion, resonance of the left side of the chest was normal. On the right side there was slight dulness anteriorly down to the fourth rib, below which resonance was normal, while posteriorly there was impaired resonance over the supraspi-

ous fossa and over the lower portion. On auscultation there were moist râles anteriorly down to the fifth rib with slight wheezing, and posteriorly crepitant râles over the right apex with diminished breathing, and moist râles over the right base. The liver and spleen could not be palpated. There was no liver dulness anteriorly. At the anatomical site of this organ there was tympany which fused with the pulmonary resonance above. The liver could not be demonstrated by physical signs. In the sputum tubercle bacilli were found. A Wassermann reaction was negative. The red cell count was 4,688,000; the white count, 10,200; hemoglobin, 85 per cent.

Stereoscopic roentgenograms of the chest were made. Dr. W. Wasson, the consultant radiologist, reported:

Moderately advanced pulmonary tuberculosis with considerable inflammatory mottling throughout right lung and annular shadows in upper right. Some bronchial change in left lung with few areas of inflammatory mottling. Dr. Wasson's attention was called to an abnormal appearance of the right lower thoracic region. Instead of the large well defined outline of the diaphragmatic dome into which the upper surface of the liver snugly fits, it presented a large shadow resembling an air space, limited above by a curved line presumably the diaphragm and below by a light irregular shadow. Fluoroscopy showed the upper shadow to be freely movable and to be the diaphragm, beneath which was an area filled with gas and resembling a loop of the large intestine, moving with the diaphragm and located between it and the liver. The patient was then given a barium meal and a series of plates and fluoroscopic examinations were made, which revealed the following: The stomach was found to be normal as to location, size and time of emptying and the small intestine normal. A barium enema was then given, and the caecum was found in the median line in the pelvis. From it the ascending colon curves outward, then upward along the right wall of the abdomen up to a point about midway between the iliac crest and the costal arch. It then turns sharply to the left and ascends in front of the liver to its upper surface where it describes a sharp hook bending on itself on a horizontal plane. It is then continued toward the umbilicus where it describes a double loop in the shape of a knot, from where it continues to form the sigmoid and rectum.

It was thus established that the questionable area beneath the diaphragm was a loop of the colon lying between the diaphragm and the liver. On a lateral X-ray plate the liver appeared to be widely separated except posteriorly from the diaphragm and was pushed backward, resembling in roentgenograph the sagittal section pictured by Curschmann.

DISCUSSION

Embryology. In order to obtain a better insight into the possible etiology of this anomalous position of the large intestine, especially the transverse colon, it seems advisable here to review briefly the embryonic development of the caecum and colon. The colon and caecum (4) are

formed from the posterior limb of the U-shaped intestinal loop.[1] At the end of the first month of foetal life an elevation is formed which afterwards becomes the caecum and appendix. At first the colonic part of the intestinal loop and the caecal process are not of larger calibre than the small intestines, but during the fifth month the colon and caecum undergo an enlargement, but the terminal part of the caecum retains its foetal dimensions and forms the appendix. The superior mesenteric artery descends into the loop and gives off three branches to the posterior limb; the middle colic, right colic and ileo-colic arteries.

At the seventh week the great growth of the anterior limb, to form the coils of the jejunum and ileum, causes the U-shaped loop to rotate so that the splenic flexure of the colon comes against the spleen. This brings the transverse mesocolon, containing the middle colic artery, against the part of the mesogastrium which forms the great omentum. These two layers adhere: thus the transverse colon is formed by the fusion of a part of the dorsal mesogastrium with the mesentery of the posterior limb of the U-shaped loop. The rotation places that part of the mesentery loop which forms the ascending mesocolon against the duodenum and at the same time the duodenal loop is pressed into its permanent position in front of the right kidney and inferior vena cava; the caecum thus comes to be situated in the majority of foetuses in front of the right kidney, near the gall bladder, and there it remains until about the time of birth, when both the caecum and ascending colon undergo a gradual migration towards the right iliac fossa. The cause of this migration is probably due to a functional elongation of the proximal part of the colon, but it occurs only in animals adapted to the upright posture.

At the time of birth the liver occupies about half of the abdominal cavity. The explanation of the anomalous location of the colon in these cases is of course open to a great deal of conjecture as is also the approximate time of its formation. That it is congenital or was occasioned early during life seems to be without doubt. Whether this location was occasioned by actual pathological processes giving rise to adhesions with subsequent dislocation in association with other viscera—the diaphragm or the liver—or whether abnormal conditions such as the accumulation of gas and feces (or meconium) present in the colon itself may not have led to an abnormal lengthening with consequent anomalous position of the transverse colon is uncertain.

[1] The following description is practically that given by Keith.

SUMMARY

A case of anomalous colon in a consumptive is presented with complete roentgenological study. The anomalous colon was discovered during a routine roentgenological chest examination when there was found under the right diaphragm a large air containing sac, proved by subsequent examination to be a portion of an elongated transverse colon which lay on the anterior surface of the liver, the latter being pushed backwards, while the colon was found in direct contact with the diaphragm reaching the top of the dome on the abdominal side.

The authors wish to express their appreciation to Drs. H. J. Corper and Harry Gauss for their kind coöperation and advice given during the preparation of this paper.

REFERENCES

(1) Curschmann, H.: Die Anomalien der Lage, Form und Grose des Dickdarms and ihre klinische Bedeutung, Deutsch. Archiv. f. klin. Med., 1894, liii, 1.

(2) Horand, M. R.: Colon transverse s'insumant entre la face supérieure du foie et le diaphragme, Lyon Med., 1903, c, 427.

(3) Barton, J.: Case of abnormal position of large intestines, Trans. R. A. of Med., Ireland, 1889, vii, 392.

(4) Keith, A.: Human embryology and morphology, 1913, p. 272.

FIG. 1. SAGITTAL SECTION OF CURSCHMANN'S CASE

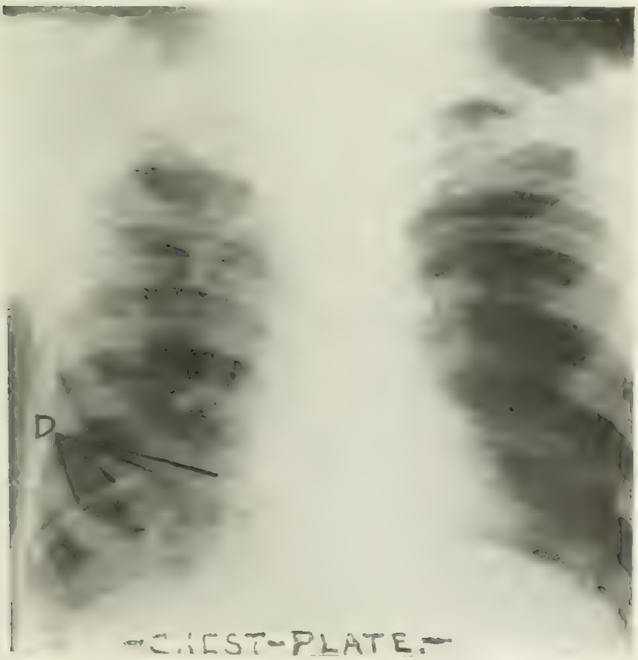

FIG. 2. ORIGINAL CHEST PLATE
D, position of diaphragm corroborated by fluoroscopy

FIG. 3. INTESTINAL PLATE MADE TWELVE HOURS AFTER INGESTION OF OPAQUE MEAL
D, diaphragm. *T.C.*, transverse colon

FIG. 4. LATERAL VIEW TAKEN TWENTY-FOUR HOURS AFTER OPAQUE MEAL
D, diaphragm; *T.C.*, transverse colon; *L*, probable location of liver

Fig. 5. Abdominal Plate Taken Immediately after Opaque Enema

T.C., transverse colon; *L.*, probable location of liver

EARLY VERTEBRAL TUBERCULOSIS WITH CLINICAL PICTURE SUGGESTING RENAL CALCULUS

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In 1917 there was admitted to my service a middle-aged, married woman of slight figure and neurotic temperament, who complained of pain in the right lumbar region. The trouble was of several months' duration. Both the site of the pain and its association with a slight frequency of micturition suggested the right kidney as the source of trouble. This organ was palpable, movable, not enlarged and only slightly, if at all, tender.

Cystoscopic examination showed a normal bladder. No pus cells or tubercle bacilli were to be found in the urine. By catheterization of the ureters practically normal urine was obtained from both sides, though there were a few red blood cells in the specimen from the right kidney.

In the roentgenographs a number of faint shadows in the neighborhood of the right kidney suggested the existence of renal calculi. One of these lay in the kidney shadow; while others like it were to be seen nearer the vertebral column, or along the border of the last rib, beyond the margin of the kidney. None of these shadows appears in the reproduction of the plate made at that time (fig. 1), as they were too faint to show in the print; but they were similar in character to the shadow seen in the picture of this patient taken on her second admission, six months later (*a*, fig. 2). It was extremely doubtful whether these shadows were thrown by renal calculi; some of them certainly were not. But in view of the character of the symptoms and of the fact that the physical examination was otherwise negative the decision was reached, somewhat reluctantly, to explore the kidney. I had recently removed a renal calculus from a patient who had spent some time in another hospital suffering from a vague backache, which was regarded as osteo-arthritic in origin, the calculus being entirely overlooked; and decision to operate was doubtless somewhat influenced by this experience.

The kidney was about normal in size. A few small calcified nodules were felt in the surrounding fat. The organ was split open and no

FIG. 1. ROENTGENOGRAPH MADE ON FIRST ADMISSION TO THE HOSPITAL

Compare lumbar vertebræ I and II with those shown in the plate made six months later (fig. 2).

stone found. On the basis of the experience of certain surgeons to the effect that pain of renal origin may occasionally be relieved by stripping back the capsule, this was done; there was, however, no particular anatomical indication for it. The kidney was anchored in place. Though

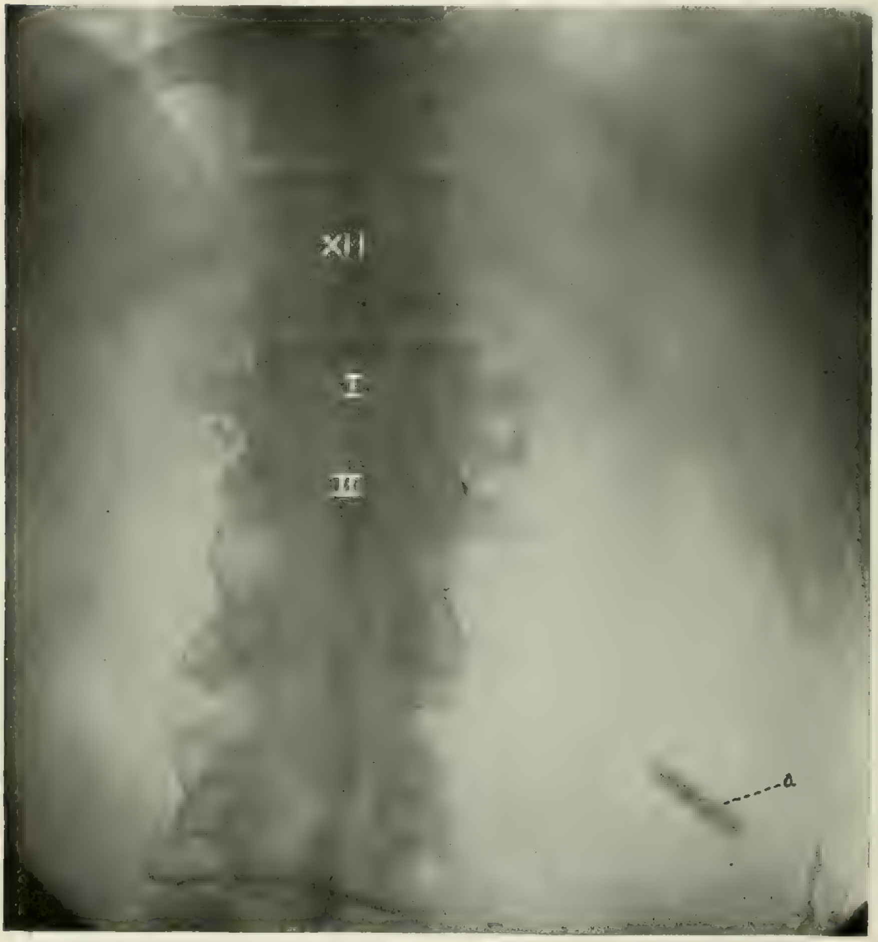

FIG. 2. ROENTGENOGRAPH MADE ON SECOND ADMISSION TO THE HOSPITAL

A well-marked caries of lumbar vertebræ I and II is present

there was not the slightest reason to anticipate such a result, all symptoms disappeared after the operation; in four weeks the patient left the hospital happy in spirits and free from pain.

Six months later she was readmitted, bed ridden and suffering from great pain in the back. Examination now revealed a well-marked kyphos at the site of the first and second lumbar vertebrae. The X-ray picture showed a destruction of the first lumbar intervertebral disk, with caries and fusion of the bodies (figure 2). The natural supposition was that this lesion had been present when the patient was first admitted and had been overlooked; but examination of the picture of the vertebrae taken at that time proved that this was not the case. The bodies, spines and transverse processes were at that time clear in outline and normal in density; the intervertebral cartilages showed no sign of disease (fig. 1).

This was clearly a case of galloping tuberculosis of the spine, first manifesting itself in symptoms which there was some justification for regarding as renal. I do not think there was anything in the roentgenogram made during the first stay at the hospital on which a diagnosis of tuberculosis could have been made or suspected. This may be only another way of stating the fact that the early lesions in tuberculosis of the bones and joints either fail to manifest themselves in the X-ray picture, or manifest themselves in a way which we are, at present, unable to interpret. On the other hand it may be that, had we suspected the spine in this case, a more detailed study of the vertebrae would have revealed changes which we did not detect in the routine examination. It seems pretty certain that the operation in this case lighted up the process; at any rate advance of the disease between hospital admissions was rapid.

The lesson of this observation is clear. I cannot make out, from my notes made during this patient's first stay in the hospital, that a diagnosis of vertebral tuberculosis was ever seriously considered. It certainly should be considered whenever pain in or near the costovertebral angle is complained of; and in this particular patient the shadows of calcified glands should have given us a clue. It is not certain that, even had we looked for it, the spinal tuberculosis would have been found; but I think it not unlikely that some reflex muscular protection, so commonly found in early tuberculosis of bone or joint, would have been detected.

WORK FOR THE TUBERCULOUS

WHAT IS SUITABLE AND WHAT UNSUITABLE FOR THE DISCHARGED TUBERCULOUS MAN

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The day a man leaves the sanatorium with anything like arrested tuberculosis, like the day a boy is graduated from college or university, is not an end, but a beginning; not a valedictory occasion, but a "commencement." The use of learning is sometimes more difficult to master than learning's self, the application of principles harder than the comprehending of them. The student in the sanatorium, which is, being interpreted, the school for the tuberculous, has presumably been well taught. If so, his back-to-home-and-work course of instruction has not been neglected.

The general practitioner of medicine who sent the man to the sanatorium cannot be counted a safe guide as to what he should or should not do on his return. He is apt to be less right in matters of treatment than in diagnosis, and still less right in after-treatment than in treatment. The sanatorium physician, who should have expertness in the treatment of tuberculosis, and whose daily contact with the patient has extended over months, has utterly failed in his duty if he has not stood with him on the threshold of the new adventure and worked out with him what should and should not be done on his return home.

Sanatorium treatment for pulmonary tuberculosis dates back seventy years, and began to be general about thirty years ago. Fairly general agreement as to its guiding principles has been reached by sanatorium men of experience. These principles are as definitely standardized as those of surgery, but they are not as familiar to the medical profession or to the general public as the principles of surgery and they run counter to many old prejudices, as indeed the principles of modern surgery did a generation or more ago.

The essentials of the treatment of tuberculosis are frequently—and wrongly—stated to be "food and fresh air." The real essential, as sana-

torium men all know, is *regulation of rest and exercise—of energy conservation and expenditure.* One tuberculous patient must not raise his hand to his head unnecessarily; another may do a day's work with benefit. Between these two are ranged all who have active or even fairly arrested tuberculosis, and the placing of a man where he belongs is a matter of experience, study and skill. He who can direct wisely regarding *rest* and *exercise* can treat tuberculosis. He who cannot do this can only maltreat tuberculosis. And only he who can bring to the treatment of tuberculosis thought, experience and skill, has any right to try to direct either the treatment or the after-employment of the tuberculous.

Rigid and uniform rules cannot be applied. No two tuberculous patients are the same in physical condition, resistance to disease, aptitude, experience, history, upbringing or surroundings. Each case, therefore, presents new features for consideration. But while rigid rules are not applicable, a few general principles may properly be outlined.

1. Work for those with arrested disease *must not be physically heavy.* Hard labor kills the tuberculous. When the time comes for getting back to work, the fortunate are those whose education and previous training open up to them light suitable occupations; the unfortunate are those who know only the pick-and-shovel sort of work, and whose lack of education and experience or whose foreign tongue shuts them out from any more suitable employment.

Tuberculosis lies hidden away in us like the charge in the old shot gun in the chimney corner, harmless until some person, or some circumstance, pulls the trigger. The most common trigger puller, is, in a broad sense, dissipation, the over-spending of energy. Energy expenditure must be kept within energy income. Over-expenditure of muscular energy is most dangerous for a tuberculous patient.

2. Possibly the most deeply rooted wrong idea concerning work for tuberculous persons is that outdoor occupations are essential. Almost every patient comes to the sanatorium in a mental attitude of waving a fond farewell to his former occupation. He considers that he can no longer be a lawyer, or bookkeeper, or merchant, or an electrician; but must become instead, a farmer, a gardener, an outdoor time-keeper, a chauffeur or the driver of a delivery wagon. This idea,—which has not always been given him by his grandmother, but occasionally by medical or vocational adviser or nurse,—is wholly and utterly wrong. An outdoor occupation *may* be preferable to an indoor one, other things being equal, but the trouble is that other things cannot and will not be made

equal. If weather were always good, and jobs as varied, suitable, light and remunerative outside as inside, outdoor work would be chosen; but suitable well-paid, physically light, permanent out-door jobs are as scarce as bank-presidentships. Even fairly suitable outdoor jobs are few, and suitable indoor jobs are so much more numerous, that one whose daily task it is to consider and plan the after-course of tuberculous patients comes almost to disregard the occasional outdoor opportunity and almost as a rule to advise indoor work.

The chief objection to an indoor job is its indoor-ness. But if a man has to be indoors at his work eight or ten hours a day, he has still fourteen or sixteen hours of the twenty-four, most of which, by sleeping out of doors, he can spend in the open air. Indoor work and outdoor sleeping should be as suitable a routine as outdoor work and indoor sleeping, even if fresh air were the only essential, which it is not. There is no climate known in which an arrested tuberculous patient, working in the open, is not exposed to most unfavorable conditions many times in the three hundred and sixty-five days of any year. If an outdoor occupation be the only suitable one, why do so many farmers become tuberculous?

A clerk in a railway freight office was noticed to be coughing and not doing well. The manager, in mistaken kindness, gave him an outdoor collecting job, and to make it particularly suitable, put him on a suburban beat where walks were long and air supposed to be free and pure. A fortnight of carrying a weak body and a heavy overcoat through snowdrifts and zero weather finished that man. The secret of his bad condition was not that he was in an office all day, but that he was physically overworking before and after office hours helping his wife to run a boarding house. It can easily be seen how the collecting job finished him.

3. *It is particularly necessary that a tuberculous person should earn a good wage* so as to make good living conditions possible. This is so important that it should be a chief consideration even to the exclusion of some other considerations. Within his own home, a man who has lost his leg can live, without disadvantage, at exactly the same standard as before his injury, but a tuberculous man cannot do this. He needs better and more spacious housing, with balcony accommodation. He should even be able to waste fuel to some extent, letting fresh and cold air in and, incidentally, heated air out through opened windows. He requires better food, better clothing, better mattress, better bedding and more of it, and likely shorter hours of labor than he did before. He

needs, therefore, a higher-paid occupation to insure against breakdown. Training, which increases the earning capacity of a tuberculous patient and enables him to earn more dollars and earn them more easily, is a wise investment which will prevent many a breakdown and give a good profit even in dollars and cents.

4. *A tuberculous patient needs a permanent occupation.* To give him merely "something to go on with" is usually a mistake, especially if he be at the occupation-learning age. His condition is not temporary, but in some degree, at least, permanent, though likely to improve with care, and a suitable occupation will be needed not only this year and next year but ten years hence. An occupation with a future, which will be suitable ten years hence is, needless to say, the one which should be entered upon to-day. There is perhaps a fair prospect of his handicap becoming less as the years go by, and a blind-alley occupation, which leads nowhere, is not good enough for him.

5. *If at all possible, it is better for a man to return to his old occupation or some modification of it.* His old job is easy to his hand, like an old glove; he can measure his capacity and avoid over-exertion in it better than in another; and in it he escapes the worry and uncertainty of learning new work. Employment in his old work is more easily secured. He knows its ropes and may be at work the week after the doctor pronounces him fit. A workman's trade is his capital, slowly acquired like the merchant's business, and to ask him to give it up is like asking the merchant to burn down his warehouse, destroy all his records, cancel all his connections, and begin without resources to build up another and a different business. When a workman, trained in a trade, gives up that trade and begins to learn a different one, the loss to the individual and to the state is the *same kind* of loss as the burning down of a factory. It is the destruction of an asset personal and national.

It is sometimes particularly suitable to train a man in an improved grade or variation of his old occupation. He thus turns to account all his old experience, and adds to his aptitude. Accordingly, a clerk who has had little training may be taught the work of a bookkeeper or learn shorthand and become a secretary; a machinist may be developed into a draftsman; a carpenter may become a supervisor of work; a farmer may retain his old experience but have a lighter and more suitable job with shorter hours by learning to run a gasoline tractor.

6. *A suitable job for a tuberculous patient should be one which makes it possible for him to live at his own home.* The work of a salesman or com-

mercial traveller may not be unsuitable if confined to the bounds of a city but may become one of the most unsuitable occupations when it involves travel away from home. One of the essentials to success in keeping tuberculosis arrested is a good suitable home, and all the advantages of this are lost and all the disadvantages of unsuitable surroundings added, when a man's home is any hotel he may chance to reach for the night. In salesmanship, some lines involve few calls, light samples, and a high degree of skill, while others involve heavy samples and many calls, with less skill. Work of the first sort may be quite suitable and work of the second sort very unsuitable.

It is a truism that actions are not always good or bad in themselves, but in their relations; sin is conduct out of place. So, considering all different circumstances, it is impossible to divide occupations into two lists, "good" and "bad." What is bad for one tuberculous man, in view of his condition and many sets of circumstances, may be good for another, differently placed, and in a different physical condition.

While this is the case, and definite white and black lists are impossible, it may be advisable to discuss one or two occupations concerning which, popular ideas are especially wrong.

There are physicians who never see farms except from Pullman windows, who sit comfortably in city offices and advise men more or less broken by tuberculosis to *go farming.* In their mind's eye they see a picturesque homestead with sloping fertile fields, a placid stream or two, lawns and orchard, ample buildings,—a picture of peace and plenty. They think of a hammock in the orchard, horses and carriages, fresh eggs and cream, abundant hospitality, all modern improvements, all the comforts of life; and they advise the man physically and financially "broke" to "go farming." The farm they see in their dream is an exceptional farm—a very exceptional farm, altogether likely a monument to the labors of the grandfather of the present farmer. It may be available for a son or daughter or a fortunate nephew who needs to recuperate, but on a farm, when actual work begins, friendship ceases. The *prosperous* farmer, or his son, or guest, can possibly employ themselves in easy and picturesque and not altogether un-useful ways, and modify the farm routine as necessary. But the man who has no training and no start, who must work for a farmer, or hew out a farm for himself, is committed to one of the most unsuitable of all occupations for a tuberculous patient.

And while the exceptional farms are very attractive, average farms rank low. Houses are small, ill-ventilated, badly heated, not very well kept; rooms are small, sanitary conditions are bad. Hours of work are long, as chores of various sorts are added to the regular day's work. The farmer knows no forty or forty-eight hour week but more probably a seventy-five hour week. All weathers must be faced and all emergencies met, and, even in an age of machines, much drudgery and hard physical labor remain. The man without capital, whether working for himself or for another man, has the hardest work and the greatest amount of drudgery and any soft jobs or easy circumstances necessarily belong to the man with the capital.

One who has had a considerable farming experience, whose condition is extra good, who is in the position of owner and who can develop one of the less laborious lines of farming, may, even if not "well fixed," return to farming with benefit to himself and the country. No absolute rule can be made, but for an inexperienced man with arrested tuberculosis, farming, unless under exceptional circumstances, is an utterly unsuitable occupation.

Gardening has been looked on as an easy, suitable and even poetic form of farming. "God Almighty first planted a Garden; and, indeed, it is the purest of human pleasures. It is the greatest refreshment to the Spirits of Man," quoth Lord Bacon. And who would not have been refreshed by wandering among his cypress trees, ivy, bays, rosemary, lavender, periwinkle, "the white, the purple and the blue," the sweet marjorum, the double peony, the lilies "of all natures," and the scores of his other flowers and fruits, his fountains, walks and walls? But it is most unlikely that Lord Bacon ever turned a single sod in the garden, and he certainly did not have to have his carrots and parsnips in the London market by cockcrow. He knew the poetry, but not the prose, of gardening.

Gardening as an outdoor fad or a backyard asset or a patriotic spurt may be all very well, but, as a means of earning a living, it is no job for a tuberculous person and a mighty hard job for one with all his usual powers. It is something like farming by hand without machinery, and he who will garden for a livelihood must be up before the lark and still up long after curfew in order to reach his customers with the fresh products of his garden. Let the outdoor faddist soberly compare the dollar with which the weary gardener returns to his home late at night with the dollar the bookkeeper earns in a comfortable office, and decide if the fact

that he has been outdoors in a drizzling rain all day inclines the balance in favor of the gardener's occupation for a tuberculous man.

One of the occupations freely recommended for tuberculous patients is the *care of chickens*. I have been told that any one who runs a chicken ranch successfully has brains enough to be a college president. I know very little in a practical way about the care of chickens. But I have yet to be converted to the idea that the various operations necessary in chicken raising are particularly suitable to tuberculous patients and have yet to be shown any considerable number of real successes either in money or in health.

Much has been said, especially as the end of the war came in sight, and particularly in England, about *colonies for the tuberculous*—centres residential and to some extent industrial. It is presumed that many could live and work under good colony conditions who could not make good under ordinary living and working conditions. Every individual tuberculous person constitutes a special problem, and no universalrule will apply to all. From a fairly broad experience with sanatorium patients, however, it seems to me unlikely that many will be found for whom the tuberculous colony would be the ideal solution. Those by whom it would be most needed might with the greatest difficulty be induced to enter, while those who were anxious to prolong dependence might be hard to break away. A trial must be made not only in one country and for one class, but in each country and for each class. What might be very suitable in England might be entirely unworkable in Western Canada.

Such a colony would, in my opinion, do its best work when it most definitely served as a stepping stone to the return to an ordinary place in the community. Nothing should be done to delay the return to his ordinary employment and ordinary conditions for the man who is anything like suitable for that return. The ideal should be the man back in his own place as *often* and as *soon* as possible.

Any scheme of help, however good, impairs to some extent individual initiative. By observing side by side in sanatorium treatment soldiers and civilians one comes to realize how valuable are individual initiative and individual sense of responsibility, and how much can be lost by impairing these by any scheme, however good.

Whatever plan may be devised and whatever occupation decided on for men with arrested tuberculosis, individual initiative and what used to be known as "gumption" are most important constituents of success. Backing and help are all very well but a man can often do with and for

himself what no one can do for him. I have known a voiceless patient with advanced disease, barely arrested, plan out for himself a new occupation and keep his family in comfort for years, at the same time doing the useful work of a good citizen. Such initiative and gumption can be coddled out of a man.

Many men when they return home fail, not because of over-work, but of over-play. A man may be said to spend all the time he has in *work*, *play* and *rest*. The tuberculous man who has to increase his time of rest must increase it at the expense of the work period or of the "play" period. If he can afford to do so he may choose play—that is, unnecessary employment, and proportionately drop work, which is for most people, necessary employment. But for most men returning to their homes work has to come first. With them the choice has to be made between shortening what I have called the "play time," the time of unnecessary energy expenditure of various sorts, or cutting short the rest time.

One very common cause of breakdown—indeed the most common cause—is the choice of *both work and play* in full measure—men insisting on having everything in their lives that they had before, with no abatement whatsoever, no allowance for the extra needs of a diseased body. The tuberculous man must be willing to sacrifice something, perhaps much. He must "deny himself and take up his cross," if he is to be a true disciple.

While much, indeed most, depends upon himself, yet a good start is of utmost importance and any advice a patient is to receive should be well thought out according to right principles.

THE INFLUENCE OF CLIMATE AS DISTINGUISHED FROM FRESH AIR IN THE TREATMENT OF PULMONARY TUBERCULOSIS AND ITS COMPLICATIONS

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Much has been said on the influence of climate in the treatment of pulmonary tuberculosis, but very few definite conclusive facts have been established. Most extravagant claims have been made by some advocates of the climatic treatment; while other observers have claimed with equal vehemence that climate has absolutely no influence whatever. Both these extremists are manifestly mistaken. That pulmonary tuberculosis has been cured in all climates is abundantly proved by post mortem examinations; that many cases have improved and many others arrested in one climate, though they had become progressively worse or failed to make any improvement, under almost identical care, in another climate, is a matter of fairly common observation. Somewhere in the vast expanse between these widely divergent views lies the truth, but exactly where seems absolutely impossible to determine in the present state of our knowledge. So intimately is the influence of climate interwoven with that of care—fresh air, good food and rest—that it seems quite impossible to separate the influence of one from that of the other, to analyze the relationship of one to the other or to determine exactly the relative value of each. All one can do is to review and correlate certain fairly well established facts, indicate in a general way their probable significance and leave the conclusions to the judgment or prejudice of each individual observer.

In attempting to solve a problem of this kind two sources of information are available; first, fairly well established conclusions founded on experimental investigation and, second, opinions based on wide clinical experience. The former is perhaps the more definite; the latter is certainly the more reliable, if founded on unbiased judgments. An endeavor will be made to draw from both these sources of information.

Theoretically the most convincing way to determine the relative importance of different climatic factors in the treatment of pulmonary

tuberculosis would be to select a number of units of say 100 each, of patients in similar physical condition in all stages of the disease, and each unit in exactly the same way but under different climatic conditions of temperature, purity of atmosphere, percentage of sunshine, relative humidity, altitude, etc.; and compare the results. Such a plan is manifestly impracticable. The nearest approach to it which is feasible would seem to be to compare the results of the same treatment of the same patients, in the same locality, at different seasons of the year. The monthly and yearly reports of the United States Weather Bureau prove conclusively that the climate of the same locality differs at various seasons of the year just as surely as do the climates of different localities. In other words there is a distinct seasonal climate as well as a climate of locality, and the elements of each are essentially the same. Herein may lie the answer to this vexed and complex question. A careful study along these lines by competent observers in different parts of the continent, should, after a few years, place at the disposal of the profession an accumulation of well established facts sufficient to solve this problem in most of its details. For the present, however, we must content ourselves with a few general conclusions drawn from the meagre observations on the influence of seasons in the treatment of this disease.

The late Dr. E. L. Trudeau, the founder of the open-air treatment of tuberculosis in America and the man whose unbiased opinion probably carries more weight than that of any other American writer on tuberculosis, says, "The hot weather is, I think, unfavorable to phthisical patients and the greatest improvement takes place from early fall to early spring." A careful study of the records of the Adirondack Cottage Sanatorium has proved quite conclusively the truth of Dr. Trudeau's opinion. In fact statistics and observations from all parts of the world, in every climate in which tuberculosis is being treated, tend to verify his statement.

This one fact, almost universally admitted, that patients wish pulmonary tuberculosis show greater improvement at certain seatons of the year would seem to be conclusive proof that climate does have an influence on the treatment of this disease.

At the Adirondack Cottage Sanatorium, for instance, the patients are the same. They spend the same number of hours in the fresh air. They eat the same food. They rest the same number of hours. They have precisely the same care at all seasons of the year. The only difference is in the weather, the climate. Therefore, climate must have a definite influence in the treatment of pulmonary tuberculosis.

"But," you will ask, "what particular influence has climate?" It seems quite clear that in this locality the climate of the fall and winter has a more favorable influence than that of the spring and summer; but to what extent each particular element of climate influences patients it seems impossible to determine at present. In a general way, the fall and winter climate is cooler than that of the spring and summer; and the air is probably drier, especially during the intense cold of the winter months, when the rivers and lakes are frozen over; and it is probably purer (that is, freer from organic matter and bacteria), particularly during the winter months when the whole country is covered with a thick mantle of snow. We would seem justified, therefore, in adding that the facts seem to indicate that the combination of cold with dryness and purity of atmosphere very probably constitutes the advantages of the climate of the fall and winter months, and that each of these three elements of climate is in itself a distinct benefit.

COLD

There is a rather remarkable unanimity of opinion among clinicians in all parts of the world regarding the beneficial influence of cold in the treatment of pulmonary tuberculosis. In fact this is the one and only element of climate regarding the benefits of which all students of tuberculosis agree. In all climates from the Arctic Circle to the Equator the cooler months are the ones in which tuberculous patients make the most marked improvement. Within the Arctic Circle seems to be the only part of the Northern Hemisphere in which the summer climate is better suited for the treatment of tuberculosis. No attempt, however, seems to have been made to determine what degree of cold is most beneficial. Unbiased judgment would seem to indicate that a moderate degree of cold—sufficient to stimulate metabolism without the necessity of an excessive amount of clothing—would probably be most desirable. The fact that at North Reading, Massachusetts, the greatest percentage of patients gained in September and August, and in Pennsylvania in October and November, while at Saranac Lake, September far surpassed every other month, would tend to verify the correctness of this conclusion.

Regarding the amount of cold desirable for each individual patient, this should be determined by the individual's powers of reacting to cold —just as in the case of the water bath. If a certain degree of cold is

followed by a "healthy glow" of the skin it is of distinct benefit. If, on the other hand, it causes blueness, "goose flesh," and discomfort, a warmer atmosphere is desirable. As in the case of the water bath most patients can be gradually hardened to enjoy a moderate degree of cold in the atmosphere. Reference will be made later to the fact that in the milder climates the beneficial effects of cold may be obtained by exposing the naked body to the air.

PURE AIR

For a number of years most observers have agreed that pure air is a very necessary climatic element in the treatment of pulmonary tuberculosis. The fact that the sites for all sanatoria, public and private, have been selected away from the smoke and dust of cities and, where possible, on elevated ridges in sparsely settled districts, is sufficient proof of this. Careful laboratory observations have proved that the purest air—that having the greatest freedom from smoke, dust, organic matter and bacteria—is to be found in the Polar ice fields, in mid-ocean, on very high mountain tops, in pine forests and on the desert. A thick coat of snow lying on the ground continuously for several months contributes greatly to purity of atmosphere; as do also a high percentage of sunshine and absence of vegetation. In the habitable portions of this continent, where proper facilities can be had for the care of tuberculous patients, the pine woods of the East and North during the winter season, when the ground is thickly covered with snow, and the desert regions of the Southwest at all seasons of the year, offer the greatest advantages so far as pure air is concerned. Ocean travel is not to be recommended in the treatment of pulmonary tuberculosis. Reference will be made later to the beneficial effects of life at the seashore in the treatment of surgical tuberculosis. Where chemically and bacteriologically pure air is not obtainable, use should be made of an abundance of the best outdoor air available in that locality. Constant air movement is an important consideration in all localities, but more especially in those in which a really pure air is not obtainable. Patients should not only live out-of-doors but they should be surrounded with moving air at all hours of the day and night.

SUNSHINE

Although Osler as far back as 1893 placed pure air and sunshine at the head of his list of desirable attributes of a suitable locality for the treatment of pulmonary tuberculosis, a number of prominent students of this disease appeared to doubt the efficacy of a high percentage of sunshine in its treatment. They pointed to excellent results obtained in climates where the percentage of sunshine is small; and from this fact jumped to the erroneous conclusion that sunshine has little or no influence on the tuberculous process.

It was not until about 1913, when a knowledge of the results of Rollier's treatment of surgical tuberculosis by exposure of the whole body to the influence of the sun's rays, began to be widely disseminated, that sunshine was given a definite scientific place in the armamentarium of those who treat tuberculosis. For years previously the general impression among physicians was that sunshine probably had a beneficial effect on tuberculosis by purifying the atmosphere, and by its moral effect on the spirits of the patient; while those who practised in regions where the percentage of sunshine is high were firmly convinced of its efficacy but could advance no definite conclusive proofs in favor of their opinion. The remarkable results obtained by Rollier constitute one of the brightest pages of modern surgery and prove beyond a doubt that sunshine is the most potent agent we possess for the cure of surgical tuberculosis. This much has been conclusively proved; but to what extent and how the direct rays of the sun affect pulmonary tuberculosis has not yet been definitely determined.

Rollier's vast laboratory and clinical experience has convinced him that the beneficial results of sun and air baths in surgical tuberculosis are due more to their general effect in increasing the individual's resistance to the disease than to their local action on the diseased tissue. If this view is correct, sunshine should be a valuable therapeutic measure in the treatment of pulmonary and laryngeal tuberculosis. Clinical experience in Europe and on this continent is beginning to indicate its real value in these forms of tuberculosis. "Laryngeal tuberculosis has been treated since 1905 with great success by Sorgo. The same method has been adopted by Baer, Runeauld, Weiss, Faussen and Alexander."

Rollier says,

Concerning the treatment of pulmonary tuberculosis, there prevailed, up to very recently, in medical circles, the opinion that those with lung tuberculosis should avoid the sunlight. They accused the sun of various misdeeds. Among other things, it was said to cause fever, congestion and hemorrhage. It required some courage to fight against this assumption and to free oneself from the exaggerated fear which, even to-day, overcomes some physicians. During our work in the field of surgical tuberculosis (since 1903), we have had opportunity to observe and treat by heliotherapy a great number of surgical cases who also had lung tuberculosis, and we *have never observed an unfavorable effect*. On the contrary, we have *always noticed an obvious improvement* in the lungs under the influence of the sunlight combined with the high mountain air. . . . We always succeeded in avoiding the much dreaded congestion by the cautious application of insolation, and we came to the conclusion that the hyperemia of the skin is an excellent decongesting agent for the inner organs and, consequently, also for the lungs. But just here individualization is of the greatest importance. According to our observation, the youthful cases of tuberculosis, with little infiltration of the apices, and especially children, are most benefited by the sunshine.

The writer's very limited experience would lead him to believe that exposure of the arms, legs, and sometimes of the abdomen to the sun and air is of distinct benefit in selected cases of pulmonary tuberculosis with moderate fever; but that the general sun and air bath (that is, exposing the whole body to the sun and air) should be reserved for patients with normal temperature who are about ready to begin carefully graduated exercise. In fact the general sun bath should be regarded as a mild form of exercise, and as such it seems to have a distinct place in the treatment of many cases of pulmonary tuberculosis. Our experience has been that its most striking benefits have been found in those well-nourished patients (often much above normal weight) whose temperature remains normal as long as they are kept at rest in bed, but who immediately begin to have a rise of temperature on the slightest exercise. The sun bath will often increase the powers of resistance of these patients in a few weeks to such an extent that they can be safely put on carefully graduated walking exercise. Incidentally, in many instances, it removes their superfluous flesh. Some febrile cases will tolerate sun baths of the arms, legs and abdomen, but will begin to show elevation of temperature when the chest is exposed to the sun. Many of these are apparently benefited by the sun bath, when the chest is kept covered, either permanently or until its exposure to the sun does not pro-

duce fever. Experience would indicate that the general sun bath is of distinct benefit in laryngeal tuberculosis, and quite lately a few cases have been reported in which the reflection of the sun's rays into the tuberculous larynx seemed to have a beneficial effect on the local tuberculous process.

DRY AIR

As previously hinted, clinical experience suggests that dry air is probably of distinct benefit in the treatment of pulmonary tuberculosis. Inasmuch as a low relative humidity is usually associated with pure air and very often with a high percentage of sunshine, it is very difficult to distinguish the influence of one from that of the other. Many observers have been impressed with the markedly good effect produced on the cough and expectoration of most cases of tuberculosis by a dry atmosphere. Patients, themselves, are usually the first to comment on this fact. It has been found that the killing of bacteria by sunshine is most easily accomplished in dry air. While excellent results in surgical tuberculosis have been obtained in the humid atmosphere of the seashore, practically all authorities agree that most pulmonary cases are not benefited by residence at the seashore. A combination of high relative humidity with low temperature is probably always distinctly harmful in pulmonary tuberculosis; but some cases undoubtedly do better in warm, fairly moist, equable climates. This is especially true of those advanced in years, cases with kidney involvement, and those in the later stages of the disease with low vitality and profuse expectoration.

ALTITUDE

The influence of altitude on pulmonary tuberculosis has been the subject of more vexed and acrimonious discussion than that of any other element of climate. The advocates of both sides have apparently failed entirely to influence the convictions and prejudices of their opponents and the wordy warfare still continues. There is no doubt that large numbers of cases of pulmonary tuberculosis have become quiescent and arrested in high altitudes. Whether or not these cases would have recovered equally as well at lower levels there is apparently no method of determining definitely. Statistics have proved nothing on account of the difference in patients, and in methods of classification. At the present time, however, arrangements are being completed to remove the

patients from one of the oldest and best equipped sanatoriums in Arizona at an altitude of 1090 feet to the mountains, at an altitude of 5300 feet, for the summer months. A comparison of the accurate and detailed records of this institution during the winter months on the desert with those of the summer months in the mountains, at a high altitude, should, after a number of years, give considerable definite information concerning the influence of altitude in the treatment of tuberculosis. The advocates of altitude have shown that the proportion of red blood corpuscles and of hemoglobin is considerably increased and that the arterial blood contains considerably more oxygen at high altitudes. Whether or not these changes are due to altitude *per se* is still a subject of debate. It is clear, however, that altitude carries with it purer air and more abundant sunshine; and to this extent it must be a desirable element in the treatment of tuberculosis *unless* its injurious effects more than offset these advantages. Perhaps the most remarkable demonstration of the adaptability of man at all ages to high altitudes without any deleterious effect is found in the Grand Canyon of Arizona. There, during the past twenty years, tens of thousands of tourists of all ages have been taken from an altitude of 7000 feet at the rim of the Canyon to less than 2000 feet at the river, and back in the same day; and two years ago the management reported that it had not been found necessary to call a physician to attend a guest there since the hotel was opened twelve years before.

The work of Rollier in surgical tuberculosis has called attention to the influence of the sun's rays at high altitudes, Professor Rosselet, Rollier's collaborator, ascribes the main effect of light in the sun treatment to the ultraviolet rays. By comparing these rays in the mountains and on the plains he found that even when the weather is ideally clear the ultraviolet rays are more intense and more numerous at a higher altitude. This difference tends to disappear in the summer time, but it is very great in the winter. The luminosity of the sun in winter is six times greater at Davos Platz in the Alps than at Kiel at sea-level, and somewhat less than twice as great in summer. In winter the effect of light is increased by reflection from the snow, and its chemical qualities are augmented.

To quote from Rollier:

From these considerations we see that the most advantageous way to take the sun treatment is in the high plateau region during the winter months.

The strength of the sun's rays is in direct proportion to the altitude. At the lower levels the sun's rays, coming down through the air, come in contact with dust particles, bacteria, mists, etc., and lose about 90 per cent of their effectiveness.

On the other hand the chief effect of light on the body is pigmentation of the skin caused principally by the ultraviolet rays. It is a matter of common knowledge that pigmentation of the skin takes place readily at the seashore; and since Brannan has reported excellent results in the treatment of surgical tuberculosis at Sea Breeze on the New York coast and similar excellent results have been obtained for years at the seashore sanatoriums of Italy and France, the conclusion seems justified that the sun's rays at the seashore have an especially beneficial effect. One wonders if the pure air of the seashore and the reflection of the sun's rays from a large body of water are not factors in increasing the effect of light. Naturally the great advantage of altitude in the use of the sun's rays is the much higher percentage of sunshine found at the higher levels. Regarding the influence of the sun's rays at lower levels on the desert, little has been determined; but, since pigmentation is easily acquired there, these localities are probably very suitable for sun treatment during the cooler months of the year. Here, too, pure air and the reflection of the sun's rays from the vast expanse of the desert probably increase the effects of light on the body.

CONCLUSIONS

From the foregoing facts we would seem justified in coming to the following distinct conclusions:

1. There is no specific climate for the treatment of pulmonary tuberculosis.

2. Varying degrees of cold, abundance of pure air and the largest possible percentage of sunshine are *certainly* of distinct benefit in the treatment of all forms of tuberculosis.

3. Dry air is probably beneficial in quite a high percentage of cases of pulmonary tuberculosis.

4. Altitude is *certainly* beneficial in all cases of surgical tuberculosis and is probably of considerable benefit in quite a large percentage of cases of pulmonary and laryngeal tuberculosis.

5. The seashore at all latitudes is *certainly* beneficial in all forms of surgical tuberculosis. In the colder latitudes it is not beneficial in pul-

monary tuberculosis, but in the warmer more equable latitudes it is suitable for the treatment of certain cases of the pulmonary form of this disease.

In endeavoring to make practical application of these conclusions the question of the relative value of climate at once obtrudes itself on our attention. To quote from a former paper:

As between care (that is fresh air, good food, rest and competent medical attention) and climate, the latter must always continue to be a secondary consideration. In the least favorable climate, good care, provided the surroundings be the best obtainable, will produce much better results than the best known climate without this care. If the patient must choose between the two, he should take the care and let the climate go; but if he be so fortunate as to be able to have them both, his prospects of recovery are certainly brighter than they could be if he were compelled to depend on one alone.

LITERATURE CITED

Hinsdale, G.: Smithsonian Miscellaneous Collections, Vol. 63, No. 1.
Burns, N. B.: Boston M. & S. J., April 9, 1914.
Brown, L.: Amer. Med., April 25, 1903.
Schaeffle, K.: Nat. Tuberc. Assoc. Tr., 1917.
Mills, C. W. and Forster, A. M.: Ibid., 1918.
Rollier, A.: Verhandl. d. Gesellsch. f. Kinderheilk. d. 84 Versamml. d. Gesellsch. deutsch. Naturforsch. u. Aerzte im Münster, 1912.
Rollier, A.: La cure du soleil. Balliere & Fils. Paris, 1914.
Barlow, W. J.: Jour. A. M. A., October 28, 1911.
Flinn, J. W.: Interstate Med. J., May, 1914.

PRESIDENTIAL ADDRESS[1]

THE PRESENT STATUS AND FUTURE PROSPECTS OF THE TUBERCULOSIS CAMPAIGN

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I have spent some time during the current year in trying to satisfy myself concerning the present status and future prospects of the campaign against tuberculosis. It is my purpose to give in this paper a brief statement of the conclusions which I have reached.

In the first place, it seems to be thoroughly established that practically no child is born into the world with tuberculous infection. Tens of thousands of autopsies, and many more applications of the tuberculin test, have demonstrated the fact that congenital tuberculosis is exceedingly rare. Besides this, the weight of opinion at present is that there is no inheritance of even a predisposition towards this disease. Tuberculous cows are used in Denmark and elsewhere for breeding purposes. If the calves produced by these cows be immediately separated from the mothers at birth and permitted to nurse healthy cows or are fed upon sterilized food, they grow into healthy animals. The same thing on a smaller scale has been shown to be true in the human race. Tuberculosis is always an acquired disease and never inherited. While during the fifty or more years preceding the World War the death rate from tuberculosis was constantly decreasing, the percentage of tuberculous infection has been increasing; in other words, we have a lessened mortality from this disease and a greater morbidity. The causes of this increase in tuberculous infection should give us great concern. It has been shown that the greatest increase in tuberculous infection has developed in cities, and especially in those cities where the homes are overcrowded. This is an age of great crowded cities, with skyscrapers reaching toward the heavens. It is more than probable that the census for the present year will show that quite half of our population is urban. Every city

[1] Delivered at the General Session of the Sixteenth Annual Meeting of the National Tuberculosis Association, Saint Louis, Missouri, April 22, 1920.

in the country from the humblest village to the great metropolis is hoping that the census will show a great increase in its population. Is this desirable? Does it endanger the health of the masses? Can mankind at large best develop physically, mentally, and morally in great cities? While tuberculous infection has greatly multiplied in cities and while much of our rural population is still badly housed, the rate in the increase of tuberculous infection has been most marked in the cities. Quite one-half of our population is to-day living in cells. Some of these cells are crude and unfit for human habitation, while others are gilded and supplied with the richest and most ornate furniture; but all are cells.

We might learn a lesson from a study of the prevalence of tuberculosis among cattle. According to Moore, this disease is rare among the range cattle from the West and Southwest that come to the markets at Kansas City and Chicago; on the other hand, tuberculosis is common in the dairy herds in every part of the country. Housing is the greatest problem, as I look at it, in the tuberculosis campaign and the greatest factor in the increase in tuberculous infection. Something must be done which will turn the current and drive our people from the cities to the country. At present every incentive leads in the opposite direction. The farmer and his sons are leaving their tillable lands, moving to the city, going into business for themselves or becoming employees in mercantile, manufacturing, and other industrial plants. The young man who has recently married and with the prospect of a family ahead of him knows the difficulty of properly rearing his children in the country. The hardships of rural life are still great. The educational and cultural opportunities for himself, wife, and children in the country are meagre, but the most potent influence in driving the farmer to the city is a financial one. The man who stays on his farm cannot get laborers, because he cannot afford to pay the wages these men receive in industrial plants. In order to do this he would be compelled to sell his wheat at many dollars a bushel. He certainly cannot keep his laborers if he must sell his produce at the figures now prevailing, as great compared with the past as they are.

In my opinion, no nation can greatly improve when so large a proportion of its inhabitants are living a parasitic life; and all cities are parasites. The fundamental necessities of life are food, clothing, shelter and fuel. The miner who digs the coal may go on a strike and compel us to pay whatever price he sees fit to demand. The lumberman, and

other providers of shelter material, may hold their products, either in the raw or partially manufactured state, until they get what they demand; but all food and clothing come from the soil, and the farmer owning the soil cannot afford to strike. He, however, is likely to do something that will be more drastic than going on a strike. He will produce what he needs to feed himself and his family, while he and his boys will go to the city and make much more than they possibly can on the farm. Argument is of no value in presenting this point. Facts are more potent than logic. Under present conditions there is every reason that the strong and vigorous man, be he poor or rich, should go to the city.

A few days ago a wealthy manufacturer, with his shops located in a most charming village so far as natural scenery is concerned, came to me complaining bitterly because there is no physician in his place. He pointed out the natural beauties and advantages of the location. I asked him whether his family lived in the village. He said no, his family lived in Detroit. I asked why. He said, "There are in the city educational and social advantages that do not exist in my village." "But," said I, "you expect a young physician with the prospect of a family to live where you will not permit your own family to live." This is exactly the situation prevailing over a large part of the country. I am told that in a certain section of Illinois where the surface produces the best corn in the world the farmer and his sons are working beneath the surface in the mines, while the wife and younger children are scratching the surface and producing just enough to feed themselves. I am also informed that more than one-third the acreage of the State of Michigan will not be under cultivation the present year. As I see it, the time is coming and coming quickly when the scarcity of food and clothing will drive the people from the cities to the country. This will right itself in time, but at how great a cost to the nation I am not able to estimate.

In England, where there is so little land, the people apparently desire to get near it and are building garden cities, like Letchworth, Port Sunlight, and other places. In this country, where we have so much land, we try to get as far from it as possible, and the importance of a city is estimated by the number of high buildings it possesses.

In our cities nearly one hundred per cent of the adult inhabitants are already infected with tuberculosis. It is a serious question how nearly normal any individual or mass of individuals can be when all

are infected with the bacillus of tuberculosis. I am inclined to the opinion that the well-nigh universal infection with tuberculosis now existent among us is already telling upon our national character. If universal infection with malaria had anything to do with the decline of Greek and Roman civilization, what may universal infection with tuberculosis do for us? It may be that some twenty centuries in the future some learned professor will write a monograph, entitled: "Tuberculosis as a factor in the decline of the civilization of the twentieth century."

We are very properly establishing tuberculosis sanatoria, hospitals, and colonies for the care of those afflicted with this disease. We must continue to do this, but we must realize that we shall never eradicate the disease by these measures.

In order to eliminate this disease and its evil consequences, whether they be manifest in increased death rate or in increased morbidity, there must be radical changes in our methods of living. When the young city minister, lawyer, doctor, clerk, or artisan develops tuberculosis, if we detect the disease in its incipient stage, we send him to a sanatorium. There we give him complete rest, good food, and instruct him in methods of living; but when his time is up, what can he do? There is only one thing for him to do, and that is to return to his former vocation, and in the majority of instances he relapses, spreads the disease to his family and others with whom he comes in contact, and finally himself dies from it. Wise men see these things and attempt to supplement the tuberculosis sanatorium with the colony, where the young man is taught some light handicraft, preferably something that will enable him to live out of doors; but he cannot stay in the colony indefinitely and when he comes out to practise this recently acquired handicraft he must compete with men who have been in this specialty all their lives. Necessarily he is a failure and he goes back to his old life with almost uniformly the result as indicated above.

We must clothe agricultural labor with greater dignity and reward it more liberally; we must surround it with all the educational and cultural conditions which are now found only in the city. Every boy and girl should have a manual as well as a mental education.

Unskilled labor is now demanding six working hours a day and five days a week, and we sneer at it for making such a request. If every adult worked four hours a day in some productive capacity there would be no scarcity in any of the necessities of life. It is estimated that even

with crude agricultural implements the average number of hours per year necessary to get the greatest production from an acre of land amounts to only two hundred and twenty. There is much justice in the demand of the unskilled laborer, but the trouble is that he at present would not wisely spend the remaining eighteen hours. A large number of unskilled workmen break down at present from tuberculosis, but their misfortune is not always due to hard labor; rather to the manner and place in which they spend their nonworking hours.

I am told that tuberculosis is a result of our civilization. I prefer to say that it is an incident of our civilization, and when we become really civilized we shall not be content to live in cells, be they crude or be they gilded. Most of the so called educational and cultural advantages of the cities today are not worth anything and many are positively injurious. We are gregarious animals. We flock together; we like to live in crowds; we find enjoyment when we mingle in great numbers; we are not yet intellectual enough to live in even partial isolation. The masses, both rich and poor, fail to find enjoyment in the library, in the workshop, in the garden, or in the field.

It must not be concluded from what I have said that I am a pessimist in the fight against tuberculosis. I certainly am not. Man will ultimately eradicate this disease just as he placed malaria, yellow fever, typhoid fever, the bubonic plague, and other diseases under his authority, but before he accomplishes this great task there must be a radical change in his manner of living. In the meantime, it is our duty as physicians and health workers to educate the people, especially the children, to build sanatoria and colonies, but we must recognize at all times that these are only milestones on the road of human progress and that they must be passed and left far behind before man reaches that degree of intellectuality which is essential to proper living.

There has been much discussion in Congress recently over universal military training. I believe most heartily in the draft. Every American citizen should be required to do his duty, alike in war and in peace. I believe in universal disciplinary training and I should like to join a political party which would favor the drafting of all young men from seventeen to twenty years, compelling them to do agricultural work for three months out of each year. If it be the duty of every citizen to protect his country against a foreign foe, and I take it that there is no division on this point, it should likewise be the duty of every citizen to contribute to the production of the necessities of life. Privately

owned land should not be allowed to lie idle and unproductive while the owner is waiting until the energy and industry of others render it more valuable. I may not see things straight, but as I look into the future it appears to me that the greatest need of our people is increased production of the necessities of life. If this be true, the Government should make every effort to favor agriculture, even if it be necessary to occupy privately owned lands temporarily.

Much enthusiasm is now being manifested for vocational therapy. We are boasting that we are going to train our ex-soldiers who have suffered impairment, either through wounds or disease, in some useful vocation. Vocational therapy has its place and should be fully employed, but like all other therapeutic agents, its range of usefulness is exceedingly limited. The enthusiasm with which we talk about it is in inverse proportion to the soundness of thought that we bestow upon it. It is true that there are some men who will not only take care of themselves, but will even do great things and far surpass their average fellows, after they have met with some mutilating misfortune. Within my own narrow circle of acquaintances I know one man who, although he was deprived of his sight many years ago, has made of himself since that accident a great authority in the chemistry of steel and iron. One of my most honored professional friends has been totally blind since he was twelve years of age. We all know men who have done great things after losing a hand or a leg, or sight, or hearing. We know men who have done great things even while tuberculosis was constantly sapping their strength and shortening the road to the grave; but these are exceptional men, and no amount of patience, enthusiasm, or good sense will convert thousands of soldiers who have acquired tuberculosis into skilled mechanics, who will be able not only to support themselves but their families. The exaggerated enthusiasm that we are displaying for vocational therapy and the good that we are claiming is to come from it are more complimentary to our good intentions than to our intelligence. I believe in vocational training. Every individual should have it, but it should come in youth and as part of the education supplied by and demanded by the state.

The tuberculosis problem is so intimately bound up with those pertaining to the general public health that its detachment is impossible. It has been shown by figures that the introduction of pure water supplies and improved sewage disposal has not only reduced deaths from typhoid

fever and other intestinal diseases, but also saved thousands from tuberculosis. A large number of typhoid patients carry latent tuberculosis, and even when they recover from the more acute infection they fall victims to the more insidious and pertinacious invader. Each has his special panacea for doing away with tuberculosis. One thinks that the great cause of this disease is alcoholism; another that it is insanitary housing; and yet another that it is need of fresh air. Underfeeding, insufficient clothing, imperfect lighting and ventilation in homes and in factories, infected dust, and many other things are held responsible for the wide prevalence of this disease. Yes, it is each and every one, and all of these untoward conditions of life which convert the latent tuberculous case into an open one, remove the seal from the culture tube and scatter its contents broadcast.

Measles, scarlet fever, diphtheria, influenza, and various other acute infections prostrate many of those with latent tuberculosis, possibly taking their death toll from many, but even those who recover find that their span of life has been materially shortened, because the intercurrent disease has so weakened bodily resistance that sleeping tubercle bacilli have awakened and have fallen more earnestly and more effectively to their work of the destruction of vital organs. War, famine and pestilence have in the last few years materially reduced the population of certain areas, but the deaths caused by these agencies directly will be greatly increased by the wider prevalence of tuberculosis among those who have survived. The death rate from tuberculosis is climbing already in every country which has felt the effects of the World War, and it will probably be many years before this rate falls to the pre-war level. It may possibly be that the World War will ultimately give the people who engaged in it better government and better conditions of living, but for some years to come we must expect the tuberculosis death rate to go up in every country in direct proportion to the increased stress and strain of living which have been imposed upon its people.

It is an old and repeated observation that tuberculosis is a frequent sequel to measles, scarlet fever, whooping-cough and other acute infections. Whether these diseases cause lesions, thus affording more ready entrance of tubercle bacilli into the body, or whether the sequence is due to an awakening of already established tuberculous foci, may be a matter for debate. Probably both things happen. Measles, for instance, is accompanied by marked alterations and with the production

of many minute lesions in the mucous membrane of the respiratory tract. Through these breaks in continuity tubercle bacilli may more easily than under normal conditions find their way into the body. However, there are reasons for believing that measles not only opens up new portals for infection, but that in the majority of instances, where the sequence beween these diseases is noted, it is due to previous infection with tuberculosis. The tuberculous processes develop so quickly after measles that it is hardly possible, at least in the majority of instances, to suppose that infection with tubercle bacilli has not preceded the acute attack of measles. Moreover, there is scientific testimony which, if we interpret aright, bears upon this question with great weight. It has been frequently observed in cases where the tuberculin test has been made that prompt and vigorous response has followed, showing undoubtedly the existence of tuberculous infection. When cases of this kind are attacked by measles, both during the attack and for some time thereafter, they fail wholly or partially to respond to the tuberculin test. Response to the tuberculin test indicates, as we understand it, that the body cells have been sensitized and are pouring out secretions, the purpose of which is to counteract the multiplication of tubercle bacilli in the body. When measles comes on in a tuberculin positive individual these specific secretions evidently lose, for the time being at least, something of their specificity and are utilized in the combat with the measles virus. Consequently, when the Pirquet test is made, cellular secretions fail partially or altogether to have any digestive action on the tuberculin introduced in the scarified tissue. This is a result which we can see, and we assume that a similar phenomenon is taking place in the one or more tuberculous foci which may exist in the body; in other words, the body cells being threatened with subjugation by the virus of measles turn their every energy into combat with this foe, and even go so far as to withdraw those agencies whose specific purpose it has been to combat the tubercle bacilli. During the continuance of the attack of measles these antituberculosis secretions are exhausted. They have spent their energy not in combat with that enemy against which they have been trained, but against one which threatened speedier and more widespread destruction; in other words, the offensive weapons of the body cells have been for the time withdrawn from the siege of tuberculosis forces and turned against a new enemy which is advancing over wider areas and possibly threatening points of great strategic importance. If this be true, and there can be no question about

the frequency and promptness with which tuberculosis develops after measles, there can be no question about the importance of preventing, controlling, and modifying the attacks of measles in our effort to secure a reduction in the number of cases and deaths from tuberculosis. Not only is this true, but the matter is even of wider significance. Before the attack of measles comes on the individual in the case has latent tuberculosis. He was not a source of danger; he could go among his fellow-men, although he had tuberculous infection, without disseminating this infection in any way. The attack of measles converts this individual into an open case of tuberculosis, and not only shortens his life but renders him so long as he does live a distributor of the disease. It may be just as dangerous, both to the individual and to the community, to expose a case of latent tuberculosis to measles, scarlet fever, or whooping-cough, as to expose again such an individual to tuberculosis. Since practically all of us are infected with the tubercle bacillus, every acute disease is an intercurrent phenomenon and gives opportunity for the advance of the tuberculous processes.

I have tried my best to study the problems of tuberculosis as they now confront us in an optimistic spirit. I have even convinced myself that the present high cost of living, of which we complain so constantly, will ultimately prove of benefit to the health of the masses. As I see it, the high cost of living is in part due to the improved conditions of living demanded by the masses of the people. Those who formerly lived in shacks are demanding houses, those who a few years ago were content to pass their existence in crowded, unlighted, unventilated tenements are now seeking apartments; in fact, there has been a general move upward from the poorest classes, all demanding and in part securing better housing conditions. In this I try to see, and I think that I have some justification in perceiving, a tendency to the improvement of the living conditions of the masses of our people.

In a democratic country like ours the hovel and the palace are alike out of place. There should be neither, but every family should own and occupy a modest, sanitary home, with space enough about it for the cultivation of at least a moderate amount of food-supplying plants. This should be the ultimate goal sought by every truly democratic nation. Until some approach is made towards securing this condition we cannot hope to reduce disease to a minimum, to have a contented and prosperous people, to secure a stable and progressive government. I am aware of the fact that he who preaches the abolition of class dis-

tinction and equality in the possession and enjoyment of the necessities and comforts of life is generally regarded as a wild dreamer and classed as a more or less dangerous socialist; however, all advance in civilization, all betterment in the race, and every step in the progress of mankind, demonstrate that these are the final objective points for which the sanitarian, the educator and the statesman should strive. After all, the one thing that marks the progress of the race is the relative number of physically, mentally and morally acceptable citizens existing in a given generation. The standard by which we measure the progress of mankind cannot be applied to the individual, but must be applied to the masses. We boast, with good reason, of the civilization of to-day. We claim that it is higher and more nearly perfect than that of any preceding age. In making this claim we would lose our case in any fair court if we based it upon a comparison between a small number of our greatest men in any department of learning with a similar number chosen from the pages of Greek or Roman history. Our boasted civilization depends for the soundness of its claims upon the fact that there never was a time when the average of human life was longer, when there was greater freedom from disease, when there was a smaller number of the ignorant and dishonest. Race progress is not measured by the occasional appearance of giants in any line of endeavor, but is determined by the stature of the average individual. A few multimillionaires do not make a country rich and prosperous. An occasional great statesman in our Congress is not able to secure for us the most beneficent laws. Not one, not even a dozen Oslers make the medical profession of this country or England either skilled or learned. The measurement in all these things must be applied to the average individual.

The rate of progress to be made in the contest with tuberculosis will depend upon political, industrial, and educational conditions to a much greater extent than upon the efforts made by the National Tuberculosis Association or any other agency specifically directed to this subject. The problems of tuberculosis are so complicated and are so interwoven with everything else that pertains to human welfare that they cannot be studied satisfactorily and exclusively as isolated propositions. As individuals especially interested in these problems, we should never lose sight of them in any of our multitudinous activities. There are certain things in which the problems of tuberculosis are so plainly involved that they should receive our constant attention. In the first place, man is an animal; and it is highly desirable that he should be a

healthy animal. Without health he cannot function normally, whether this functionating involves physical, mental, or moral activities. We should, therefore, advance so far as we possibly can every rational proposal to improve the health of the people at large. Man is not only an animal, but he is a thinking animal and his thought processes can be trained. This we call education. No ignorant nation, and by this I mean one with any large proportion of illiterate people in it, can be a healthy people. We must, therefore, encourage and direct education, both general and specific. Every child in every public school in this country should be taught the facts concerning the transmission of all infectious diseases, not only tuberculosis, but other infections as well. No animal can remain healthy under insanitary conditions; therefore, proper housing of all the people should be our aim. There can be no proper physical, intellectual, or moral growth without an adequate supply of good food. We should favor every measure for increasing and making more abundant food supplies. These are broad principles which should determine the daily activities of every thinking man.

There are certain special things which the scientific expert only can do. I have not lost hope of the possibility of the discovery of some agent which will increase the resistance of the body cells of man against the invasion of the tubercle bacillus. It is not my intention to go specifically into this matter at this time. I do earnestly hope that the National Association will devote a considerable sum during the next few years to research work along this line. A review during the past few months of all the literature bearing upon the phenomenon of reinfection or superinfection in this disease has awakened in my mind at least a strong hope that something can be done in the way of vaccinating our children against this disease. We have a number of men belonging to this organization who are quite competent to undertake this work, and I earnestly hope that the National Association will set aside a sum of money sufficient to enable these men to carry out these investigations. This is the one recommendation which your retiring president desires to emphasize at the close of his term of office.

SEROLOGICAL STUDIES ON TUBERCULOSIS

THIRD CONTRIBUTION: CONCERNING PRECIPITINS AND COMPLEMENT-FIXING ANTIBODIES

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One of the most interesting problems in serology, as well as one of the most difficult of solution, is the specificity of serum reactions. We possess a wealth of experimental data relating to the specific immune bodies formed in the sera of animals injected with either dead or living microörganisms. Different serum reactions from time to time have been discovered, some of which have been applied very successfully in clinical medicine, while others have not been so practicable. Their specificity is indisputable and they have many characteristics in common. Sera, giving various reactions, may arise either from artificial stimulation or they may sometimes be found present normally.

The observation of antibodies to specific bacteria in the serum of normal individuals, who give no history of having previously experienced an infection, is mentioned by many investigators who consider their relation to acquired immunity. It must be taken in consideration that in some of these cases a disease is not necessary for the development of such an antibody. A reaction so obtained may be a response to an infection which is not followed by a clinical disease, or it may be the manifestation of a natural or normal antibody. The inability of explaining positive reactions with the sera of apparently normal individuals has discouraged many investigators, and has cast considerable doubt on the reliability of serum reactions. It is very difficult to explain the persistence of normal antibodies, as for instance the presence of normal diphtheria antitoxin, the fact that quite few persons fail to give a positive Schick test, or that positive tuberculous complement fixation occurs in about 8 per cent of apparently normal individuals. It is probable that the mechanism of antibody production is a metabolic function resulting from physiological hyperactivity of the cells.

The phenomenon of antibody formation is not at all limited to bacteria or bacterial derivatives like toxins, etc., and it cannot be looked upon merely as a complex mechanism existing for the primary purpose of protecting the body against infectious disease. It can be demonstrated where any form of protein is injected in the animal body.

The serum reactions, and especially that of complement fixation, have been one of the principal studies in our laboratory for the last six years. From time to time we have published results dealing with the different phases of the reaction. It will be perhaps of some interest to review some of the work done by one of us during these last six years.

In the first paper which appeared in 1917 (1) we presented a broader study of the reaction of complement fixation in tuberculosis based on clinical and experimental data. The second paper, in 1920 (2), dealt chiefly with the experimental side of this phenomenon. In this second paper an attempt was made to determine the antigenic properties of the tubercle bacilli giving rise to the reactions and the chemical nature of the antigens was fully discussed. Our view of the mechanism of the reaction was presented.

In this third communication we are presenting studies on the nature of the antibodies responsible for the reaction. Their physical and chemical properties will be discussed. The phenomenon of precipitins observed will be presented, as it has occurred in the serum of experimental animals.

In discussing the nature of antibody-antigen reactions we are very much hampered by the fact that antibodies have never been isolated in a pure state. In a reaction like complement fixation, we naturally observe the effect brought about by the interrelation of certain components in a highly complex and inseparable mixture. There is no question but that the reacting component appears to be colloidal or else to be one markedly influenced by a class associated with such substances.

It seems natural that, in order to make any progress in our knowledge in comprehending this phenomenon, we must study the nature of substances with which we are working. Results presented in this paper are few and of minor importance, but we believe they may add a few more observations to our knowledge of serology.

In the following study on the antibodies responsible for the reaction we used several sera in determining the nature of antibodies. Large amounts of blood were necessary in order to obtain any results and continuous bleeding was required. In 1916 the serum of a cow spon-

taneously infected with tubercle bacilli was used, but it was soon discarded for the following reasons: first, we did not know the type of the organism causing the disease, and second, the duration of the disease was unknown. The second experiment was carried on with the serum of a sheep which, previous to sensitization, had been tested with tuberculin. The blood was tested for complement-fixing antibodies before immunization and for such immunization a known type of tubercle bacilli was used. Sheep are well known to develop a high sensitiveness to tuberculin after inoculation.

ANTIBODIES DEVELOPED IN SHEEP SERUM

Tubercle bacilli were carefully weighed and suspended in 0.85 per cent salt solution. First, intravenous inoculations were made with organisms which had been heated at 60–65°C. for half an hour. This was followed with gradual increase in amounts of human tubercle bacilli, H37. Every inoculation was followed by elevation of temperature and discomfort, and the animal became drowsy and refused to eat. There were eleven inoculations of human tubercle bacilli given, suspended in 0.85 per cent saline solution, in a period of five months. The titre was 0.0001 cc. of serum for the complement fixation reaction. It was interesting at this point to see what would be the effect on the titre of complement fixing antibodies if the human tubercle bacilli to which the sheep have natural immunity were followed by an inoculation of bovine tubercle bacilli of known virulence. From the table (table 1) it can be clearly seen that a decline of titre occurred after such an inoculation. The reaction followed by the inoculation of bovine tubercle bacilli was much more severe than that followed by the human tubercle bacilli and the titre of the complement-fixing antibodies dropped from 0.0001 cc. to 0.0005 cc. Unfortunately the animal after the third inoculation died of pleuropneumonia, and at the autopsy no tuberculosis could be demonstrated. The table gives the details of intervals of inoculations, amount of tubercle bacilli used and the development of the complement-fixing antibodies as observed in the complement fixation test.

A second animal was selected for immunization, with the object of seeing what effect was produced on the antibody production by an antigen rich in split lipins from tubercle bacilli and the tubercle protein.

For this purpose methyl alcohol extract antigen was selected, because it has given us fairly good results in the complement fixation test and

TABLE 1

Development of antibodies in sheep sera

DATE	AMOUNT OF T. B. C.	TYPE OF T. B. C.	0.1	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005	0.00025	0.0001	0.00005	CONTROL 0.1
	mgm.													
IX/ 9/19	—	—	0	0	0	0	0	0	0	0	0	0	0	0
IX/14/19	0.001	H_{37}	++	0	0	0	0	0	0	0	0	0	0	0
IX/18/19	0.001	H_{37}	++++	++++	0	0	0	0	0	0	0	0	0	0
IX/27/19	0.005	H_{37}	++++	++++	++++	0	0	0	0	0	0	0	0	0
IX/30/19	0.005	H_{37}	++++	++++	++++	++++	++	0	0	0	0	0	0	0
X/ 3/19	0.005	H_{37}	++++	++++	++++	++++	++++	++++	0	0	0	0	0	0
X/11/19	0.005	H_{37}	++++	++++	++++	++++	++++	++++	++++	0	0	0	0	0
X/31/19	0.005	H_{37}	++++	++++	++++	++++	++++	++++	++++	++	0	0	0	0
XI/10/19	0.005	H_{37}	++++	++++	++++	++++	++++	++++	++++	++++	+++	0	0	0
XI/21/19	0.005	H_{37}	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++	0	0
I/10/20	0.0001	B_1	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++	++	0
II/17/20	0.0005	B_1	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++	++	0
II/21/20	0.0005	B_1	++++	++++	++++	++++	++++	++++	++++	++++	+	0	0	0
II/26/20	0.0005	B_1	++++	++++	++++	++++	++++	++++	++++	++++	0	0	0	0
II/27/20	Dead	Autopsy; no tuberculosis												

TABLE 2

Comparison of production of antibodies with the products of tubercle bacilli to that of living tubercle bacilli

DATE OF INJECTION	NATURE OF MATERIAL	AMOUNT OF MATERIAL	0.1	0.05	0.025	0.01	0.005	0.0025	0.001	CONTROL 0.2
		mgm.								
I/26/20	CH_3OH	0.025	0	0	0	0	0	0	0	0
I/29/20	CH_3OH	0.025	++	±	0	0	0	0	0	0
II/ 9/20	CH_3OH	0.03	++++	++++	++	0	0	0	0	0
II/13/20	CH_3OH	0.03	++++	++++	++++	0	0	0	0	0
II/17/20	CH_3OH	0.06	++++	++++	++++	0	0	0	0	0
II/21/20	CH_3OH	0.15	++++	++++	++++	0	0	0	0	0
II/24/20	CH_3OH	0.15	++++	++++	++++	0	0	0	0	0
II/28/20	Living TB. H_{37}	0.001	++++	++++	++++	0	0	0	0	0
III/ 3/20	Living TB. H_{37}	0.001	++++	++++	++++	++++	0	0	0	0
III/ 9/20	Living TB. H_{37}	0.005	++++	++++	++++	++++	++++	++	0	0
III/19/20	No inoculation	–	++++	++++	++++	++++	++++	++++	0	0
III/21/20	Died. No macroscopic tuberculosis									

is very stable. Ground tubercle bacilli were mixed in proportions as described in our first paper (1), left in an incubator for several weeks and in the meantime shaken. The antigen was then evaporated to dryness and, when used, was taken up with 0.85 per cent sodium chloride solution. This was then injected intravenously at different intervals and the sera studied for complement-fixing antibodies. From the table (table 2) it can be seen that the production of antibodies by using such an antigen was very slow. The titre of antibodies was only 0.025 after the seventh injection. At this point inoculation of living human tubercle bacilli was started. The result after such inoculation was striking. The titre after the third inoculation was tenfold, 0.0025 (see table 2).

It is evident that the ideal organism for obtaining a high titre of the antibodies is one not altered by chemicals or heat, but one that is living and virulent. This fact has been brought out by many investigators. Sanborn, in summarizing the literature on the use of dead and living organisms, concluded that unheated organisms have proved by far superior to the killed organisms, a fact which was corroborated by our experiments.

The sensitization of our animals was carried along until the antibodies could be demonstrated in very high dilutions. As soon as we were satisfied with the antibody titre, large amounts of serum were obtained and various studies were made on the nature of the antibodies.

THE EFFECT OF HEAT ON ANTIBODIES

The effect of heat on inactivation was first studied. The serum was diluted 1 to 20 and distributed in small test tubes and heated at various degrees from 56° to 100°C. This study was undertaken to see what parallelism existed between the antibodies responsible for the Wassermann test and the complement-fixing antibodies in tuberculosis. Tables 3 A and B, below, give the details of the effect of heat on the antibodies:

The antibodies demonstrated in the sensitized sheep sera are not destroyed even at 60°C. for thirty minutes. It will be noted from the tables that they are not at all altered and that the titre remains the same. At 70° they are practically destroyed, that is, the strength of the antibodies when the serum is heated at 70° is only 2 per cent of the strength when serum is heated at 56°. How does this compare with the antibodies responsible for the Wassermann reaction? It has been shown by Noguchi (3) that a positive syphilitic serum loses 0.9 of its titre of

antibodies when heated at 56° for sixty minutes. This loss does not take place, however, when a serum containing tuberculous antibodies is heated. From protocols we may safely conclude that the two antibodies are distinct in their behavior to heat. It must be remembered that such results were obtained with the sera of experimental animals and, if the antibodies present in the sera of patients resist such heat,

TABLE 3A

The effect of heat on antibodies

	AMOUNT OF SHEEP'S SERA							
	0.05	0.01	0.005	0.001	0.0005	0.0001	0.00005	Control 0.05
Active sera	++++	++++	++++	++++	++++	++++	0	0
5 minutes heat sera	++++	++++	++++	++++	++++	++++	0	0
10 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0
20 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0
30 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0
60 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0
90 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0
120 minutes heat sera	++++	++++	++++	++++	++++	+++	0	0

TABLE 3B

Effect of various degrees of heat on the antibodies

	AMOUNT OF SHEEP'S SERA							
	0.01	0.005	0.0025	0.0005	0.00025	0.0001	0.00005	Control 0.1
Active sera	++++	++++	++++	++++	++++	++++	0	0
56°C.—30 minutes	++++	++++	++++	++++	++++	++++	0	0
60°C.—30 minutes	++++	++++	++++	++++	++++	++++	0	0
70°C.—30 minutes	++++	++++	0	0	0	0	0	0
80°C.—30 minutes	0	0	0	0	0	0	0	0
100°C.—30 minutes	0	0	0	0	0	0	0	0

it offers a safe inactivation of the sera whereby the cross fixation may be completely eliminated. But before such a conclusion is drawn much work must be done to corroborate this finding.

DIFFUSIBILITY OF THE ANTIBODIES

The diffusibility of the antibodies was next investigated. Much work has been done on other antibodies, and we considered that a repetition might be of value to corroborate that done by previous observers. For this purpose sera were dialyzed for different periods of time.

Collodion sacs were prepared by dissolving one ounce of collodion in 500 cc. of a mixture of equal volumes of ether and ethyl alcohol. This was left standing and now and then shaken up in order to dissolve it completely. A brownish sediment settled out and it was then used. The sacs were prepared by coating the inside of test tubes, and dialyzers thus obtained were tested for their diffusibility. Small amounts of sera were very carefully put in the dialyzers with sterile capillary pipettes and dialyzed against 0.85 per cent salt solution. The dialysate was then tested every few hours and the results showed that the antibodies concerned are colloids in their nature similar in diffusibility to the antibodies obtained by immunizing animals with other microörganisms, a fact demonstrated previously by many investigators.

EFFECT OF X-RAY RADIATION

The effect of X-ray radiation on the complement and the antibodies was then undertaken. Considerable work has been reported in the last few years on the effect of X-ray radiation on antibodies. The results obtained by various workers have been very contradictory. Most of the work, however, has been done on the effect of such radiation on the production of antibodies and the complement in vivo. Murphy and Ellis (4), by exposing normal and splenectomized mice, found marked differences of susceptibility to tuberculosis in the radiated animals. Warner (5) believed that animals exposed to X-rays showed an increased production of complement, while on the other hand Simonds and Jones (6) found no difference in the agglutinins and precipitins between exposed and normal guinea pigs. The latter also found that the animals exposed to X-rays did not show much variation in the complement-fixing antibodies and the opsonins from the normal. Hektoen (7) obtained the same results. In a careful review of the literature we failed to find any account of the effect of X-ray radiation on tuberculous complement-fixing antibodies in vitro.

The object of our experiment was to find out what was the effect of X-rays on antibodies in vitro. The sensitized sheep serum was diluted 1 to 10 with 0.85 salt solution and 2 cc. of the diluted serum was distributed in small test tubes having very thin walls. All tubes were subjected to the following radiation: Coolidge tubes 5 milli-amperes, 9 inches spark, 7.5 inches distance and exposed at different intervals. Tables 4 A and B give the details.

TABLE 4A

Effect of X-ray radiation on antibodies

	AMOUNT OF SERUM								
	0.1	0.05	0.01	0.005	0.001	0.0005	0.0001	0.00005	Control 0.1
Not exposed	++++	++++	++++	++++	++++	++++	++++	0	0
Exposed 2 minutes	++++	++++	++++	++++	++++	++++	++++	0	0
Exposed 4 minutes	++++	++++	++++	++++	++++	++++	++++	0	0
Exposed 6 minutes	++++	++++	++++	++++	++++	++++	++++	0	0
Exposed 8 minutes	++++	++++	++++	++++	++++	++++	++++	0	0
Exposed 10 minutes	++++	++++	++++	++++	++++	++++	++++	0	0

TABLE 4B

Effect of X-ray radiation on antigen.

	TITRE OF ANTIGEN 1-20 DILUTION							
	0.1	0.08	0.06	0.04	0.03	0.02	0.01	Control 0.2
Not exposed	++++	++++	++++	++++	++++	++++	++	0
Exposed 2 minutes	++++	++++	++++	++++	++++	++++	++	0
Exposed 4 minutes	++++	++++	++++	++++	++++	++++	++	0
Exposed 6 minutes	++++	++++	++++	++++	++++	++++	++	0
Exposed 8 minutes	++++	++++	++++	++++	++++	++++	++	0
Exposed 10 minutes	++++	++++	++++	++++	++++	++++	++	0

The same technique was also carried out with guinea pig's sera to note the effect of radiation on the complement, as shown in table 5.

TABLE 5

Effect of X-ray radiation on complement

	AMOUNT OF COMPLEMENT. 1-20 DILUTION				
	0.25	0.2	0.15	0.1	0.05
Not exposed	C.H.	C.H.	C.H.	P.H.	N.H.
Exposed 1 minute	C.H.	C.H.	C.H.	P.H.	N.H.
Exposed 2 minutes	C.H.	C.H.	C.H.	P.H.	N.H.
Exposed 3 minutes	C.H.	C.H.	C.H.	P.H.	N.H.
Exposed 4 minutes	C.H.	C.H.	C.H.	P.H.	N.H.

Failing to destroy the complement and the antibodies by such radiation, by elimination we tried to find where the error lay. The temperature during such radiation was then studied, and it was found that at seven minutes' exposure the temperature under the tube was 44.5°C., a temperature sufficient to alter considerable units of complement. The temperature, however, was that of the human body when a fan was used in cooling the X-ray tube. It seems that X-ray radiation has no effect on the thermolability of the antibodies and the complement. The positive results obtained by some investigators could not be corroborated by us. There are so many factors which must be taken into consideration that a slip of technique may lead to a faulty conclusion. The fact that in our study the heat factor was eliminated, when the result was then negative, strongly suggests that the destruction of complement as reported by some workers is probably due to heat radiation and not to the rays themselves.

EFFECT OF DIRECT SUNLIGHT ON ANTIBODIES

The effect of direct sunlight on antibodies and on complement was also studied. Diluted serum was exposed for different times to direct sunlight and titrated. It was found that on warm days, when the solar temperature was high, a considerable amount of complement was destroyed, while, when the weather was cold and the temperature in the sun was not very high, very little complement was destroyed.

We obtained, however, entirely different results when we subjected the complement and the antibodies to the radiation of ultraviolet rays. Here the destruction of complement took place in a short time and the temperature of the radiation was that of the body. Tables 6 A and B explain themselves.

TABLE 6A

Effect of ultra violet ray on antigen

	AMOUNT OF ANTIGEN. 1-30								
	0.01	0.02	0.03	0.04	0.06	0.08	0.1	0.15	Control 0.15
5 minutes	0	±	+++	++++	++++	++++	++++	++++	0
10 minutes	0	±	+++	++++	+++	++++	++++	++++	0
15 minutes	0	±	+++	++++	++++	++++	++++	++++	0
20 minutes	0	±	+++	+++	++++	++++	++++	++++	0
30 minutes	0	±	+++	+++	++++	++++	++++	++++	0
Normal untreated	0	±	+++	++++	++++	++++	++++	++++	0

TABLE 6B

Effect of ultra violet ray on antibodies

	AMOUNT OF SERA							
	0.1	0.05	0.025	0.01	0.005	0.0001	0.00005	Control 0.1
Untreated sera	++++	++++	++++	++++	++++	++++	0	0
3 minutes	+++	++++	++++	++++	++++	++	0	0
5 minutes	++++	++++	++++	++++	0	0	0	0
10 minutes	++++	++++	++++	++	0	0	0	0
15 minutes	++++	++++	+++	+	0	0	0	0
20 minutes	++++	++++	++	0	0	0	0	0
30 minutes	++++	++	+	0	0	0	0	0

CHEMICAL NATURE OF ANTIBODIES

A study to determine the chemical nature of the antibodies was then undertaken. The relation of the lipoids to biological phenomena has received much consideration in the last few years. The nature of the antibodies responsible for the Wassermann reaction has been extensively studied. Although the antibodies giving rise to a positive reaction have not yet been separated in a pure state it is generally believed among the serologists that the antibodies are lipoid in their nature. Thus Kolmer and Pearce (8) concluded that alteration in the lipoid content of the serum has an important bearing on the Wassermann reaction. Bergel (9) from his experiments concluded that a positive Wassermann reaction is due to the presence of lipase, which is produced as a result of the antigenic properties of the lues lipoid. Citron and Reicher (10), Peritz (11) and others maintain that the lipase content of the serum is considerably increased in luetics.

Attention has not been attracted to the nature of the antibodies responsible for the complement-fixing antibodies in tuberculosis. To determine their nature an extensive study was carried on, as to whether they are lipin or protein in nature.

Fresh serum was carefully separated from the clot, and extracted with the following lipin solvents: Petroleum ether, carbon disulphide, carbon tetrachloride, acetone, ethyl alcohol, methyl alcohol, ether and benzol. One cubic centimeter of immune serum was mixed with the different solvents, shaken continuously for a long time, incubated, and extracted for twenty-four hours at 37.5°C. Thus the supernatant extract was obtained, pipetted off and evaporated to dryness. The residue was

taken up with 1 cc. of 0.85 per cent salt solution and shaken well in the shaking machine for one hour. The emulsoids thus obtained were tested for their complement-fixing properties.

From the results obtained we are justified in concluding that the antibodies bringing about the complement-fixing phenomenon in tuberculosis are not lipins.

GLOBULIN NATURE OF ANTIBODIES

Much experimental work has been done on the globulin nature of immune bodies during the course of pathological conditions.

The first to study the nature of the antibodies very carefully were Pfeiffer and Proskauer (12), who found that the globulin fraction of cholera immune sera contained the substances responsible for the Pfeiffer phenomenon. Brodie (13) concluded from his experiments that the antitoxins are found in the globulin fraction of the serum. Pick (14) likewise found that the immune bodies were associated with the globulin and not with the albumins. Ledingham (15) found after immunization of several horses with diphtheria toxin that the titre of the antitoxin could be correlated with the titre of the globulin content. Rodham (16) observed that the antibodies of the antistreptococcus serum were very much more concentrated in the euglobulin fraction and not in the pseudoglobulin or the albumin fraction. Langstein (17) and Mayer obtained an increase of globulin and a decrease of albumin in the serum of infected animals. Glaessner (18), studying animals immunized with bacteria, toxins and animal proteins, noticed an increase in the serum globulins. But when the immunization was carried on very carefully by using small amounts of antigens this increase did not take place, and such increase was not necessary for the immune body production. Disagreement on his work rests in the fact that killed bacteria were used in the experiments. Tranter and Rowe (19) found that the globulin fraction was increased in all infectious diseases with the exception of acute tonsilitis, typhoid fever and certain mild infections. In syphilis the globulin was much increased, but it had no direct relation to the antibodies which give rise to the Wassermann test.

One of the most complete works on this subject is that of Hurwitz and Meyer (20), who found that the progress of an infecton is usually associated with an increase of sero-globulins, provided that the infection is very severe.

Our aim in the first place was to determine whether the antibodies responsible for complement fixation in tuberculosis were present in the globulin fraction, and, in the second place, whether any increase took place after sensitization, and what the variation was when correlated with the titre of normal serums to that of the serum of the patient giving a positive reaction in tuberculosis.

Globulins were obtained by half saturation of the serum of sensitized sheep, having a high titre of complement-fixing antibodies with $(NH_4)_2SO_4$. The mixture of serum and ammonium sulphate was prepared and after shaking for a short time it was centrifugated at high speed for ten minutes. The supernatant fluid which contained the albumin fraction was separated from the sediment which represented the globulin fraction. The two fractions were then dialyzed for a long time in order to remove the ammonium sulphate. From time to time the dialysate was examined, and this was carried on until it was free from ammonium sulphate. The two fractions were then brought to the original volume and tested for their complement properties.

TABLE 7

Comparison of albumin and globulin fraction to untreated sera

	AMOUNT OF GLOBULIN FRACTION								
	0.1	0.05	0.025	0.01	0.005	0.001	0.0005	0.0001	Control 0.1
Albumin fraction	0	0	0	0	0	0	0	0	0
Euglobulin	++++	++++	++++	++++	++++	++++	0	0	0
Pseudoglobulin	++++	++++	++++	++++	++++	++++	0	0	0
Untreated sera	++++	++++	++++	++++	++++	++++	++++	++++	0

Our knowledge as to what the relationship of the albumin is to the globulin is still meagre. It has been observed by many investigators that during the process of dialysis some of the globulin fractions which previously have been thrown down by half saturation of ammonium sulphate are soluble in water. According to the investigations of Hofmeister and Pick (21) the fraction insoluble in water corresponds chiefly to a globulin fraction which is readily precipitated by ammonium sulphate (using 28–36 volume per cent of saturated solution). The fraction soluble in water resists such a precipitation by the above percentage and larger amounts of saturated ammonium sulphate (36–40 volume)

must be used in order to bring about a complete separation. The former is the euglobulin, and the latter are the pseudoglobulins. Following the method described above we separated the two globulins and the results obtained are presented in table 7.

In this table we see that the globulins of the sensitized sera contain the antibodies which give rise to the complement-fixing phenomenon.

The same thing was found to be true with the serum of patients giving a positive reaction. In our experience it seems that the antibodies are either part of the globulins or they are carried down with the globulins. It was also noted that there was some relation between the titre of the globulins and the strength of the complement-fixing reaction.

OTHER SEROLOGICAL ANTIBODIES

After the establishment of the agglutination reaction as a specific reaction, Kraus discovered a new serum reaction, that of precipitation. His work was soon confirmed. This reaction was observed not only when bacteria were used, but also with the use of any proteins.

The question whether the various antibody reactions which may result from immunization with a given substance are really due to separate antibodies is very important. The evidence goes to prove that a considerable degree of independence exists. Muir and Martin (22) have shown in the case of bactericidal, opsonic and agglutination properties of immune serum that these functions vary independently. Mackie observed that the complement-fixing antibodies and the agglutination phenomenon reaction are two entirely independent phenomena.

As to what relationship exists between the precipitating and the complement fixation phenomenon, we are still uncertain. Wassermann and Bruck (23) and Friedberger (24) brought out the fact that the actual precipitation formation is not a criterion of fixation. The latter has shown that the precipitating power of the serum may be destroyed by moderate heat without a corresponding destruction of the complement-fixing antibodies.

Dean (25) has analyzed the relation between precipitation and complement fixation on the basis of extensive experimentation, coming to the conclusion that the proportion of antigen and the antibodies which is favorable for a rapid and complete precipitation does not favor the most complete complement fixation. He states that the two phenomena do not run parallel courses, and that they probably represent different phases of the same phenomenon.

One attempt after another has been made to apply this phenomenon for diagnostic purposes in tuberculosis with very little success. Baldwin (26) studied this question very carefully from the experimental point of view. Using rabbits and two different antigens in producing his antibodies, he obtained sera which gave him fairly good titres of precipitins. His antigens were prepared by extracting tubercle bacilli with sodium bicarbonate. The supernatant fluid represented one of the antigens and the sediment the second antigen. After the immunization he found that there were no fundamental differences between tuberculosis precipitins. The differences were quantitative.

Bonome (27) has claimed that he was able to differentiate between human and bovine tubercle by means of the precipitin test. Stoerk, Szaboky and Porter (28) have applied with indifferent success this test in clinical tuberculosis. Time after time we have studied this phenomenon with the hope of establishing it as a test in tuberculosis, with very little success. We undertook an experiment for the comparison of the complement-fixing antibodies and the precipitins, and quantitative determinations of both were made at different intervals.

For this study three different antigens were used. It was very essential to guard as much as possible against errors which may occur from using turbid antigens. In our study we used perfectly clear antigens. Potato filtrate, methyl alcohol extract and the clear supernatant fluid of glycerin extract antigens were used.

We have stated in our former publication that the whole glycerin antigen gave us the strongest reaction in the fixation test, and that we believe that the antigenic properties depended largely on the properly dispersed phase of the antigen. This may be explained that if we separate our glycerin antigen into two components, supernatant fluid and sediment, we find that 80 per cent of the strength of antigenic properties is found in the latter fraction, while only 20 per cent can be demonstrated in the former. For example, when whole glycerin antigen was used, 0.0001 cc. of immune serum gave us a positive reaction, but the reaction could be demonstrated with only a dilution of 1 to 2000 when the supernatant fluid of antigen was used.

Active and inactive sera were used in this study. The serum was first diluted and then heated at various degrees, varying from 56° to 80°C. for half an hour. It was demonstrated that the precipitins are much more readily destroyed by heat than the complement-fixing antibodies. Thus an active serum giving us a reaction of 0.0025 lost only

a trace of its strength when it was heated for thirty minutes at 56°. The change after such heating was only in the size of precipitating particles. At 60° for thirty minutes the loss of precipitation was 50 per cent At 70° the loss was complete. It is, then, clear that the antibodies responsible for this phenomenon are more readily destroyed by heating than the complement-fixing antibodies. The minimum time of incubation for the precipitation phenomenon was found to be thirty minutes. Concentration of antibodies influenced the reaction considerably, that is, the reaction took place much more rapidly when the dilution of sera was high. The maximum temperature was twenty hours at 37.5°.

The concentration of the antigen is one of the most important factors. The reaction is much more likely to occur when we use stronger antigen and diluted sera than when we use diluted antigen and strong sera.

TABLE 8

Comparison of complement fixation to precipitation

	DOSES OF SERUM						
	0.01	0.005	0.0025	0.001	0.0005	0.0001	Control 0.1
Complement fixation 1-20 dilution glycerin antigen...	++++	++++	++++	++++	++++	++++	0
Precipitation 1-10 dilution glycerin antigen...........	++++	++++	++++	++	0	0	0
Precipitation 1-10 dilution CH_3OH antigen...........	++++	++++	++++	++	0	0	0
Precipitation, pure potato filtrate antigen..............	++++	++++	++++	++	0	0	0

This led us to believe that the substances precipitated are part of the antigen and not part of the sera.

It makes a great difference which antigen we use in the reaction. The unheated antigens always give us much better results than the heated. This is borne out by the fact that the potato filtrate antigen is the most suitable for the reaction.

It seems to us that the precipitins and complement-fixing antibodies are probably the same antibodies. The former are not so easily demonstrated until the titre of the complement-fixing antibodies is very high. The failure to demonstrate such precipitins in the patients' serum is due probably to their low concentration. It may be clearly seen from table 8 that the complement-fixing antibodies can be demonstrated fifty-fold over that of the precipitins.

Different methods of primary incubation of antigen-antibody-complement in tuberculosis fixation have been compared to similar methods in the Wassermann test. The value of the ice-chest method used in the Wassermann test has been well studied by such men as McNeal, Coca, L'Esperance, Wile, and others, who strongly recommend the ice-chest method in preference to that of the water bath at 37.5°.

The value of this method was studied at different intervals. After a careful study, running the two methods parallel, we came to the conclusion that the water-bath incubation was much superior to that of the ice-chest method. The reaction was more constant and fewer intermediate reactions were observed. This we mentioned in one of our former publications. It was then stated that the optimum temperature of a complete antigen-antibody-complement reaction was between 35° and 40°, and this was corroborated in the later study.

SUMMARY AND CONCLUSIONS

1. Sensitized animal serum having a high titre of antibodies was studied. It was obtained by inoculation of sheep intravenously with human tubercle bacilli. The titre was 0.0001 cc.

2. Dead tubercle bacilli or products of tubercle bacilli do not produce as high a titre of antibodies as the living organisms.

3. Complement-fixing antibodies resist heat better than the antibodies responsible for the Wassermann reaction. A temperature of 60°C. will not destroy the tuberculous complement-fixing antibodies obtained in experimental animals.

4. X-ray radiation, when a full erythema-producing dose is given, does not destroy the antibody, antigen, or complement.

5. Ultraviolet rays destroy the antibodies and complement, but have slight effect on the antigen.

6. Sunlight at 1600 feet elevation has a slight effect on antibodies, more on complement and least on antigen.

7. Complement-fixing antibodies are colloids.

8. They are not lipins chemically, but are either globulins or are adsorbed by the globulin.

9. The precipitins and complement fixation have been studied parallel with each other. The two antibodies responsible for the two different reactions are probably the same, but represent two distinct phases of one and the same phenomenon.

REFERENCES

(1) Petroff, S. A.: Amer. Rev. of Tuber., 1917, i, 33.
(2) Petroff, S. A.: Ibid., 1920, iii, 683.
(3) Noguchi: Serum Diagnosis, p. 84.
(4) Murphy and Ellis: Jour. Exp. Med., 1914, xx, 397.
(5) Warner: Münch. med. Wochenschr., liii, 1625.
(6) Simonds and Jones: Jour. Med. Research, 1915, xxxiii, 183.
(7) Hektoenl: Jour. Inf. Dis., 1915, xvii, 415.
(9) Kolmer, J. A., and Pearce, R. M.: Jour. Inf. Dis., 1916, xviii, 32.
(10) Bergel, S.: Zeitschr. f. Immunitätsf., Orig., xvii, 169.
(11) Citron and Reicher: Berlin. klin. Wochenschr., 1908, 1398.
(13) Peritz: Deutsch. med. Wochenschr., 1910, xxxvi, 481.
(14) Pfeiffer and Proskauer: Cent. f. Bact., Orig., 1896, xix, 191.
(15) Brodie, T. G.: J. Path. and Bact., 1897, iv, 460.
(16) Pick, E. P.: Berl. Chem. Phys. Path., 1901, i, 351 and 445.
(17) Ledingham, J. C. G.: Journ. Hyg., 1899, xxxi, 513.
(18) Rodham, J.: Berl. Chem. Phys. Path., 1902–1903, iii, 451.
(19) Langstein, L., and Mayer, M.: Berl. Chem. Phys. Path., 0903–1904, v, 69.
(20) Glaessner, K.: Z. exp. Path. u. Therap., 1906, ii, 154.
(21) Tranter and Rowe: Arch. Int. Med., 1906, xviii, 455.
(22) Hurwitz, S. H., and Meyer, K. F.: Jour. Exp. Med., 1916, xxiv, 515.
(23) Hoffmeister and Pick: Hoffmeister's Beiträge.
(24) Muir and Martin: Jour. Path. and Bact., 1912, xvi, 523.
(25) Wassermann and Bruck: Med. Klin., 1905, i, 55.
(26) Friedberger: Deutsch. med. Wochenschr., 1906, 15.
(27) Dean: Zeitschr. f. Immun., 1920, 13.
(28) Baldwin, E. R.: Studies from Saranac Laboratory, 1904–1910, p. 105.
(29) Bonome: Cent. f. Bact., Orig., 1907, xliii, 391.
(30) Porter: Jour. Inf. Dis., 1910, vii, 87.

THE RELATION OF SOUND AND LIGHT TO THE INTERPRETATION OF X-RAY EXAMINATIONS OF THE CHEST[1]

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As the lungs in life are beyond our direct vision and beyond our direct palpation we can only visualize the lungs by indirect methods. The indirect methods are the appreciation of the variations of sounds and light vibrations as they are altered in transmission through the lungs; and then only as these altered vibrations manifest themselves on the chest wall. In order to properly interpret these physical phenomona one must thoroughly understand the physical properties of sound and light.

There are two meanings of the term sound. Sound is commonly applied to any sensation derived through (organ of hearing) the ear. In this sense the term sound does not exist for a perfectly deaf person, since the hearing organ is defective. No sensations of this kind are produced. The word sound is also used in a general way to indicate the external physical condition which precedes the production of the sensation, such as vibrations of the source and of the transmitting medium. In this sense sound exists independently of the hearer. In physics this latter meaning of the term is the one chiefly used (1).

From the above definition of sound we can understand that vibrations or energy are an essential factor to be considered in the discussion of sound. Energy producing sound, as all other energy, diffuses rapidly from its source unless confined by conditions representing a greater force than the vibrations within. Sound waves travel in all directions from the source and travel to infinity. The character of the sound is not changed, but the energy rapidly diminishes by diffusion, inversely as the square of the distance.

[1] Read before the Sixteenth Annual Meeting of the National Tuberculosis Association, St. Louis, Missouri, April 23, 1920.

Figure 1 represents sound waves produced at point A diffusing in all directions and going to infinity. The energy at point A is represented by 100; the ten lines shown in the chart will represent energy of ten each. Assuming that it takes vibrations of an energy of thirty to activate the tympanum to produce the sensation of sound, it would become necessary to prevent diffusion of at least three lines, *C*, *D* and *E* this can be done by the use of an instrument, such as the stethoscope), and to conduct this energy to the ear, before the sound in the first meaning of the term could be produced.

It is the appreciation of the factor of diffusion of energy and prevention of diffusion, which may be called conduction, that makes the use of sound waves so valuable in making our deduction of lung condition.

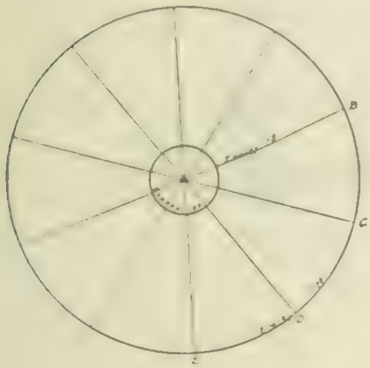

FIG. 1

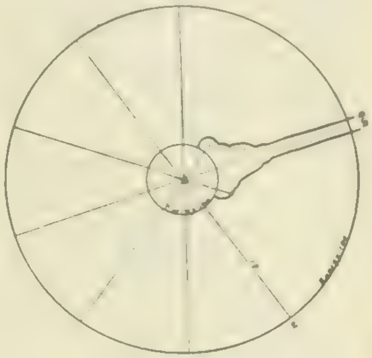

FIG. 2

FIG. 1. The illustration is made to represent an energy of 100 at a source *A*, radiating in all directions. Each line represents an energy of 10, and the larger circle represents the summation of the ten lines, which is 100.

FIG. 2. Illustrates a method by which the force of the energy, which ordinarily would diffuse in all directions from its source, can be prevented from diffusing by confining them by means of the stethoscope, and conducting to the ear.

Vibrations of the chest wall are produced by the acts of breathing, whispering or speaking. As these waves have such weak energy as they leave the chest wall, the diffusion is prevented by placing a stethoscope or the naked ear against the chest wall and the summation of this energy, as in figure 2, will produce enough energy to give an impression of sound. Each individual has a constant factor in the vocal cord and chest wall, and each hearer (physician) has a constant in the auditory apparatus. The variable factor is produced in the transmission of the energy through various densities of the lung.

I have constructed a chart, figure 3, to show the code used to translate the variations of vibrations in to lung pathology. In a previous paper, Relations of the Physical Signs to the Roentgen Plate in Pulmonary Tuberculosis, (2), I have shown the symbols I use, but I will again mention a few of them to clarify the chart:

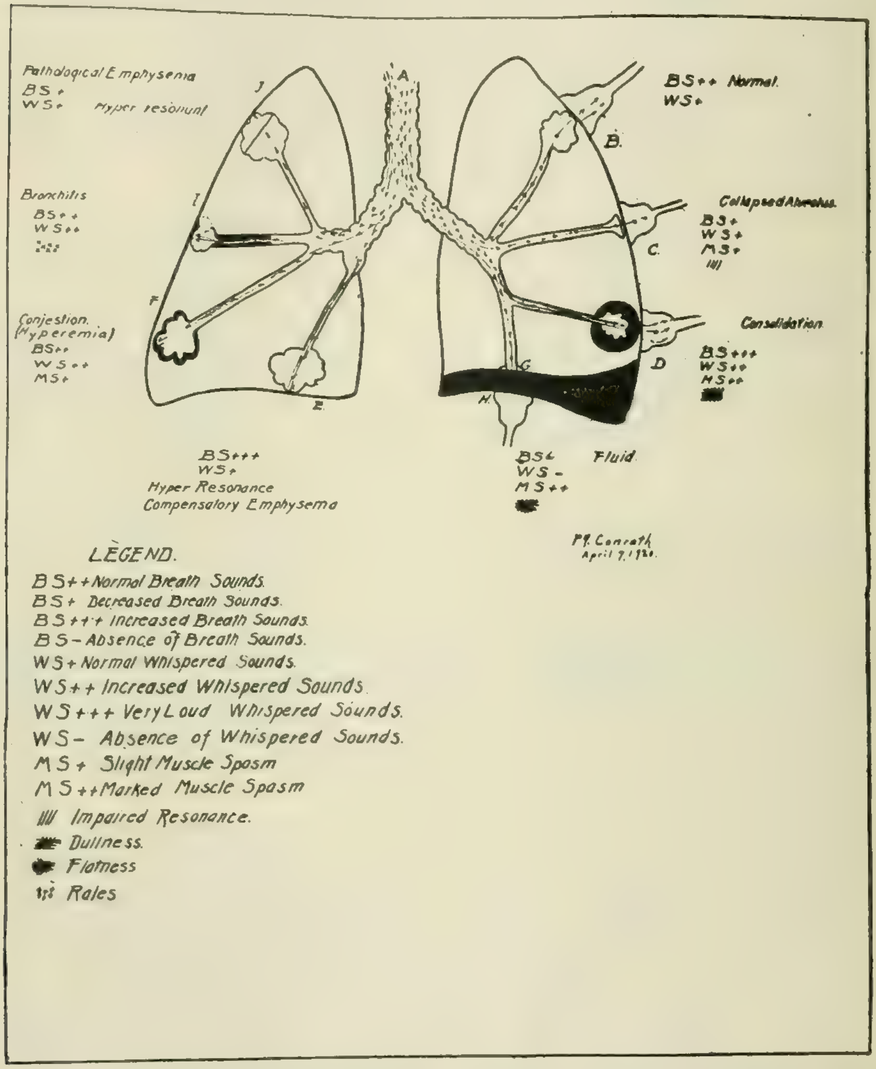

FIG. 3. This illustrates the author's chart to show the variations of vibrations of the chest wall produced by the transmission of sound waves (energy) through different media. It must be understood that it is through the combination of the sound waves produced by percussion, breath sounds, and whisper sounds that an interpretation of chest pathology can be made.

Percussion: represents a force used on the chest wall which is transmitted to the tissues beneath; the resulting vibrations travel in all directions. We are able to hear only the outgoing vibrations. The intensity and the pitch of these vibrations depend on the force of percussion, the air content of the tissue in vibration and the physical condition of the tissue. Figure 3 represents impaired resonance, dulness and flatness.

Breath sounds (*BS*): are the vibrations produced on the chest wall in the act of breathing. These vibrations are of such weak energy that they are not appreciated by the naked ear, unless the head is placed against the chest wall or confined by the means of the stethoscope and conducted to the ear.

Whisper sounds (*WS*): are produced by expiration. Air expelled from the lungs by expiration set the vocal cords in vibration and the sounds travel in all directions. We can appreciate the whisper sounds on the chest wall only by vibrations which travel downward, through the lung and out by the chest wall. The unit of lung consists of bronchus, bronchioles and alveolus as shown in diagram.

It is estimated that there are 400,000,000 alveoli in the lung. As the average lung volume is 4000 ccm., 1 ccm. equals 100,000 alveoli. If we assume that in auscultating over an area of lung we hear sounds from a depth of 3 cm., we could appreciate sound yielded by one-half a sphere 14 cm. in circumference; in other words, we would hear combined sounds of 1,400,000 alveoli (3). We can readily see that any sound heard would come from an area at least 14 cm. in circumference, and thus it would be impossible to locate changes in lung tissue at any given point. In the X-ray interpretation of lung pathology which will be shown later, these areas will be shown in still smaller variations of changes.

If we refer to figure 3 we see that the vibrations produced by breathing at *A* travel in all directions. Those that go upward, of course, never reach the chest wall. A large number of vibrations, consequently a great deal of energy, will follow along the lines of least resistance, that is, through the tube to a point *B*, where they will be diffused at the chest wall. Some of the energy will be lost through the tube walls themselves. At *B* the vibrations resulting are too weak to be heard without the use of a stethoscope or the applied ear, due to the diffusion. The character of the vibrations (vesicular breathing) I have designated in the chart as $BS++$. The whisper vibrations heard at this point will also be relatively weak; I call this vibration $WS+$. (This presumes the loss of a great deal of energy from the vocal cords as the waves pass from *A* to *B*.) The percussion note over this area is resonant. We have then three factors upon which to base our impression of the normal lung.

The normal vesicular breath sounds, BS ++, the normal whisper, WS +, and normal resonance could only result from a good air content in that part of the lung.

In explaining the sound heard at H, following the same line of reasoning as from A to B, we have the vibrations coming from A travelling down the tubes with some loss through the walls, and the energy as it reaches the wall of the collapsed alveolus G is very weak. From G the energy diffuses through the dense media with still greater loss of its energy through diffusion plus the resistance offered by the dense media, so that at H the vibrations are entirely too weak to produce the sensation of sound even with the use of a stethoscope. This I have designated BS −, or absence of breath sounds. The whisper being also relatively a weak form of energy is also diminished for the same reason (WS−). Percussion gives a flat note (high pitched). Analyzing this area we have again the three factors, diminished breath sounds, diminished whisper and flatness denoting diminished air content (4).

The above illustrations serve to explain the passage of air in two different types of transmitting media. Other variables are noted in the chart by the variations of these three factors. We have therefore percussion, whisper sounds, and breath sounds over any area in their proper combination to give us an impression of the condition of that part of the lung. As the sound waves come from such a large area it is impossible to say at what point or points certain pathology exists, except in a gross way. In the X-ray, however, we have variations of energy in points and will be explained later.

RELATION OF LIGHT X-RAY AND PHYSICAL SIGNS

In order to properly interpret the X-ray we must have a knowledge of the physics of light. A ray of light will travel in straight lines to infinity (just as any vibration will) unless it is refracted, reflected or absorbed. In relation to sound waves we found that sound waves follow the line of least resistance and will go through a tube no matter how tortuous the tube may be. This is an important factor in interpreting types of vibrations of light and sound.

From a given source of light, rays will go in all directions and the intensity of the rays will vary inversely as the square of the distance. If the intensity of the ray is 1, at 3 feet it will be $\frac{1}{9}$ and at 7 feet it will be $\frac{1}{49}$ as strong. This is because of the tremendous diffusion along the line.

In the ordinary physics of light this is spoken of as the illuminating power of the ray, but for our purpose I prefer to change the word "illuminating" to "penetrating."

TOWEL EXPERIMENT

The rays seen when viewing a light through a towel are those that penetrate between the fibers, while the others are absorbed or diminished in energy by the fibers themselves. In thinking then of penetration I would prefer to think of the variations of vibrations resulting from the resistance offered to the passage of light waves (energy), just as in sound we have variations in vibrations due to densities.

The X-rays, as given off from a tube, follow the laws of light in its penetrating powers. As X-rays penetrate various densities the potential of the individual rays, microscopical, as it were, are diminished in their path through the photographic plate. These millions of tiny forces penetrate the plate in straight lines so that the negative represents variations in vibrations (the densities in the chest being responsible for these variations of vibrations, just as sound).

The all important difference is that the plate shows these differences in densities in straight lines—that is, differences between *A* and *B* are seen at the site; while by sound the density at *A* may be appreciated an inch or so about this area.

Figure 4 is shown to illustrate the passage of the X-rays from the source through the tissues onto the plate. It will be noticed that as the X-rays penetrate the dense lines *A* and *B*, the potential of these rays are so reduced that they do not affect the plate, while the rays penetrating the air containing space between the lines *A* and *B*, meeting with a small amount of resistance such as air, affect the plate in such great energy that this area is dark. The plate, therefore, will show the lines *A* and *B*, with its air containing space, exactly as in the tissue itself. The pneumonic area around these lines is shown by the white area on the plate. We thus can see that the variations in the potential in the energy of the X-ray manifest themselves over such minute areas that the plate becomes a rather high power "picture" of the various units of the lung.

The combining of the low power method (sound waves) with the high power method (light waves) and their proper correlation will give us the factors at our command in differentiating lung conditions.

FIG. 4. A schematic drawing representing X-rays leaving the target of a tube in their path through tissue and through a photographic plate and on to infinity. The potential of the individual rays is diminished in the exact relation to the density of the media through which they travel. It also represents the rays travelling in straight lines only; and thus the photographic negative shows *A* and *B* (walls of the bronchus with its contained air) in the same relation as they are in the tissue.

REFERENCES

(1) MUMPER: Text Book of Physics. p. 237.
(2) SINGER, J. J.: Amer. J. M. Sc., 1918, clvi, 68.
(3) NORRIS AND LANDIS: First edition, p. 111.
(4) MONTGOMERY AND ECKHARDT: Pulmonary Acoustic Phenomena. 1915, p. 61.

THE WORK OF THE COMMISSION FOR THE PREVENTION OF TUBERCULOSIS IN FRANCE IN THE DEPARTMENT OF EURE-ET-LOIR

BERNARD LANGDON WYATT[1]

A survey of the tuberculosis situation in France which was carried out in the summer of 1917 seemed to indicate the desirability of making a demonstration of the effectiveness of certain principles and methods of organization, an important part of the work of the Commission.

The reason for this decision becomes clearly apparent when one considers the importance of the contributions of France to the tuberculosis problem from a scientific and clinical point of view together with the fact that in the United States a great measure of the success attained has been the result of intensive effort along the lines of organization and administration.

A centralized form of government and the division of the country into territorial units, or "departments," for administrative purposes were factors favorable to the Commission's plan of a "demonstration unit;" because a single departmental organization could serve as a model for all of the other departments and any legislative acts passed by the Chamber of Deputies and the Senate would be effective in every one of the 87 departments into which France is divided.

FACTORS CONSIDERED IN THE SELECTION OF THE DEPARTMENT

Much thought and consideration were devoted to the selection of the department in which the demonstration was to be carried out. For obvious reasons it was desirable that it should be located within a convenient distance of the Paris headquarters. The northern and eastern departments of the country were the scene of intense war activities and consequently the preliminary survey was of necessity directed elsewhere. Since 60 per cent of the population of France is rural and there are only 15 cities with more than 100,000 inhabitants, a region mainly agricul-

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tural but at the same time with some industrial activities was looked for. The tuberculosis death rate for rural France (communities under 5000 inhabitants), is 1.52 per 1000 of the population and consequently the tuberculosis mortality rate of the department was a matter of importance. The standards of living, the local transportation facilities and the existing institutional accommodations were also taken into consideration. Lastly and most important were the people themselves, for upon their earnest and active interest and coöperation the ultimate success and permanency of any plan carried out anywhere must depend to a very great extent.

THE EURE-ET-LOIR

The department of the Eure-et-Loir composed of portions of the ancient provinces of Orleanais, Normandy and Ile-de-France was finally decided upon.

This department has a population of approximately 275,000 inhabitants, an area of about 1,500,000 acres and is divided into 4 arrondissements, 24 cantons and 426 communes. Chartres, the chief city of the department, is located 88 kilometres southwest of Paris and numbers 25,000 inhabitants. With this exception and the cities of Dreux, Chateaudun and Nogent-le-Rotrou, each with a population of from 8,000 to 10,000, the inhabitants of the Eure-et-Loir live in small rural communities. There might have been certain advantages from the standpoint of combining the features of an urban and a rural demonstration organization had the department contained a city with a population approaching 100,000 but this was considered and has, indeed, proved to be a factor of minor importance in view of the activities of the Commission in Paris and elsewhere.

At Saint-Remy-sur-Avre which is located about 8 kilometers from Dreux, some 3000 men and women are employed in the manufacture of cotton goods and at Dreux employment is provided for from 700 to 800 people in other industries. Dreux may therefore be said to be the centre of the industrial activities of the Eure-et-Loir.

Topographically, the northern half of the department, (known as the Beauce), is flat and the inhabitants are engaged almost exclusively in agriculture, while the western half (perche), is rolling pasture land, and horses (the famous percherons), cattle, sheep and goats are raised there. In this connection it may be of interest to note that the psychology of the situation varied with the topography of the region and that it was a factor of very material and practical importance.

While a matter of purely academic and historic interest, the fact that Pasteur did his experimental work on anthrax at Chartres has made the departmental work of the Commission of special interest and significance to all who have had the opportunity and privilege of sharing in it.

The departmental death rate from tuberculosis was 1.62 per 1000 in 1913.

In every chief city of the arrondissements and almost every chief city of the cantons a hospital existed. In 1872 the Eure-et-Loir received a legacy which, among other things, provided for the establishment of hospitals in such chief cities of cantons as possessed no institutional accommodations and from this fund 7 small hospitals have been built and maintained. The utilization and incorporation of these institutions of the Fondation Texier-Gallas in the Commission's plan of organization will be noted elsewhere.

With reference to the local officials, the medical profession, the clergy, the school authorities, the various component societies of the French Red Cross and the other departmental organizations, it cannot be too strongly emphasized that to them belongs the greater share of the credit for the results obtained. It may be added that their intense interest and whole hearted coöperation in a common cause may well serve as a model of teamplay of the highest and most successful order.

A concrete example of the interest and initiative of the authorities in matters relating to public health is to be found in a recent report on depopulation which was made by a special commission appointed by the General Council of the Eure-et-Loir. This report deals with practically every phase and aspect of the problem in a manner which displays not only an extensive knowledge of the subject but also a thorough understanding of the measures necessary to improve many of the existing conditions.

PLAN OF ORGANIZATION

It was the aim of the Commission to coöperate with the French in the organization of the following activities:

1. A system of dispensaries for the examination of all patients and the members of their families; these dispensaries also to serve as admitting centers for the hospitals and sanatorium and as a social welfare center for the activities of the *visiteuses d'hygiene*.

2. Local hospitals, or separate wards in existing institutions for the care of patients with advanced disease.

3. A departmental or regional sanatorium for the early and hopeful cases.

4. Diagnostic laboratories.

5. Educational measures.

While the commune is the most fundamental of the administrative divisions of France and is at the same time a territorial division and a corporate personality, the number of communes in the Eure-et-Loir (426), made it necessary to look elsewhere for the "unit of organization." It was therefore decided to take the canton which is an electoral and judicial unit within the department and of which there are 24. The soundness of this policy becomes apparent when one recalls that the executive head of the department, the *prefet*, is required to work with a general council elected by the inhabitants and comprising one member chosen from each canton for a period of six years and that this council apportions the direct taxes and concerns itself with various administrative problems.

It should also be added that the 4 chief cities of the 4 arrondissements or districts (the division next above the canton) are the principal cities of their respective cantons.

With this scheme of organization as a basis the field work was begun, the general program of the Commission being presented to the Eure-et-Loir public under the auspices of the Educational Division.

THE DISPENSARIES

The organization of the medical work was commenced by the establishment of a system of dispensaries.

Dispensary plans and equipment were first standardized. This preliminary work and the policy of organizing the dispensaries in connection with existing hospitals, wherever it was possible, were factors, the value of which cannot be too strongly emphasized.

After the organization of the central dispensaries in the 4 chief cities of the 4 arrondissements (Chartres, Dreux, Chateaudun and Nogent-le-Rotrou), the work was extended to the chief cities of the various cantons until the dispensary system was completed. Twenty-four dispensaries (4 central and 20 branch dispensaries) were ultimately organized, of which 17 are in connection with existing hospitals, 4 are in rented buildings, 2 are in city halls and 1 is in a building which was formerly a private school. The Texier-Gallas Fondation, previously referred to,

had constructed 7 hospitals in the chief cities of cantons having no institutional facilities and in everyone of these 7 cities the dispensaries were established in these hospitals. In every instance, except one, the dispensaries are rent-free.

It is the custom in France to have at intervals, varying from 1 to 4 times a month, what is called "market day." The more important market days are held in the chief cities of the arrondissements and the others in the chief cities of the cantons. Large crowds from the small communes and hamlets attend and the dispensary service has been so organized that in practically every instance the clinic is held in every city on a market day and the inhabitants of the smallest rural communities are thus enabled to receive the benefit of the dispensary with an expenditure of a minimum of time and with practically no inconvenience.

LABORATORIES

A well equipped laboratory which serves the entire arrondissement was organized in connection with each central dispensary. These laboratories serve the dispensaries primarily but their facilities are also available for the various hospitals and for all physicians.

X-RAY SERVICE

Services of radiology which existed in several of the larger municipal hospitals were utilized for the dispensary work. In one instance the donation of a complete X-ray installation was made and thus both the hospital and dispensary patients provided for.

MEDICAL AND NURSING STAFF

On account of the large number of the French physicians mobilized during the war it was extremely difficult for those left at home to meet the needs of the civil population and especially was this true in the smaller cities and communes where the number of physicians even under ordinary circumstances was very limited. However, in each of the chief cities of the 4 arrondissements a French physician was found who was willing to serve as the chief of the dispensary. The American medical staff, which is limited to two for each arrondissement, works in the closest coöperation with the French physicians at the central dispensaries where consultations are held twice a week for tuberculous adults and

once a week for tuberculous children and the children of tuberculous families. The importance of a complete physical examination is emphasized. The American physicians also hold clinic sessions twice a month at the various branch dispensaries, the work being so arranged that the medical service of all the branch dispensaries in an arrondissement is under the supervision of the staff residing in the chief city. As soon as the French physicians have been demobilized the entire dispensary medical service will be transferred to them and, in case any should desire special instruction in tuberculosis, arrangements have been made whereby they may receive it.

Under the direction of a French specialist an excellent service of laryngology has been organized in connection with each dispensary and every patient receives a throat as well as a chest examination at the time of the first visit.

Patients examined at the dispensary who can afford to pay a private physician must do so and none of the staff physicians employed on a full time basis by the Commission are permitted to engage in private practice. The most cordial relations with the local departmental physicians have existed from the very first and the spirit of coöperation which has resulted has been both a great source of satisfaction and an important element of success.

Regular monthly meetings of the medical staff are held at Chartres and a circulating library with a large number of medical works and current journals (both French and English) has been established.

The dispensary and home nursing service in the Eure-et-Loir is carried on entirely with French personnel. These *visiteuses d'hygiene* have received a special training in schools organized by the French through the efforts and with the coöperation of the Commission.

The social service is organized along the same lines as the medical service from the standpoint of the relation of a central staff to the branch dispensaries.

There are at the present time 14 *visiteuses d'hygiene* in the department and there is an automobile attached to each central dispensary for the use of the medical and nursing staff.

The medical work will ultimately be done by the local physicians in the cities and towns where the various dispensaries have been established and in a corresponding manner there will be a decentralization of the nursing work. However, it is highly probable that the nursing and social service for two or possibly more of the smaller communities

should be done by one *visiteuse d'hygiene* and that such an arrangement will best serve the local needs both from a professional and an economic standpoint.

RELIEF

From the time that the dispensaries were opened until the beginning of the present year, funds for relief purposes were appropriated by the Tuberculosis Bureau of the American Red Cross.

This financial responsibility, however, has now been assumed by local committees upon which are represented the departmental and municipal authorities and all of the various organizations previously engaged in war activities in addition to prominent persons who are partisans of the policy of private initiative.

A central relief committee has been organized in each of the chief cities of the 4 arrondissements and these committees in addition to their local obligations are also responsible for the raising of funds for relief purposes in these cities and towns where branch dispensaries have been established. On each of these central committees there is a representative from the chief city of every canton in the arrondissement who is in charge of the organization of a local relief committee in the community where he resides. This representative in most instances is the mayor.

In addition to subventions from the department and the municipality money is secured by donations and through "tag-days," entertainments, etc.

The greatest interest is manifested in this part of the work, which is being carried on in a most successful manner and in which all of the people in the department are heartily coöperating regardless of religious, political or class distinctions.

INSTITUTIONS

As a result of the very close coöperation between the departmental and the municipal authorities, the local hospital boards, the Tuberculosis Bureau of the American Red Cross and the Commission and by means of appropriations by the French and the American Red Cross an institutional program consisting of 5 local tuberculosis hospitals, a day-camp and a departmental sanatorium is in course of realization.

In every instance the beds for patients with advanced disease have been established in connection with an existing hospital which has assumed all of the administrative responsibilities; in other words, instead

of creating separate institutions for the care of such patients a tuberculosis service has been added to the local hospitals. The advantages of such a plan of organization from every point of view are too obvious to require amplification.

At Chartres, 24 beds are available at the Hospice St. Brice and from 45 to 50 more at Haut Saint-Jean will soon be ready. This latter institution is being remodelled and adapted for the care of tuberculous patients and will be maintained under the direction of the Chartres General Hospital.

At Dreux a separate pavilion with accommodations for 36 patients, situated on the grounds of the Dreux General Hospital has been provided with cure galleries, and has been in operation since July 4, 1918.

A pavilion with 20 beds is in course of construction at Chateaudun which will constitute the tuberculosis service of the Chateaudun Hospital and 25 beds are being provided in a separate pavilion on the grounds of the hospital at Nogent-le-Rotrou.

Hospital beds have thus been provided in the chief city of each of the 4 arrondissements and patients requiring hospitalization can be taken care of in the arrondissement in which they reside.

In addition to the beds described above, numbering more than 150, the central administrative Board of the Texier-Gallas Fondation has offered one or two beds in each of its seven hospitals for patients whom it may be desirable to keep under observation for purposes of diagnosis, etc.

A day-camp with accommodations for approximately 25 patients has been built on the dispensary grounds at Chateaudun and is operated in conjunction with the dispensary service, the local dispensary committee providing the funds for its maintenance.

A departmental sanatorium with an initial capacity of 100 beds has been voted by the general council and the money for its construction is already in hand. Appropriations from the State (300,000 francs), the department (300,000 francs), and the American Red Cross (300,000 francs), have made this institution possible and its facilities will be available for patients in the early stage of the disease residing anywhere in the department.

EDUCATIONAL MEASURES

No campaign against tuberculosis can secure the best and most satisfactory results unless a presentation of the fundamental facts of correct and healthful living are made a prominent part of it. Unfortunately,

these facts are known by a limited number of persons and it is essential that the scientific knowledge of the few be made available for all.

The fundamental on which public health education is based is the love of life and the desire to prolong it that is inherent in each individual and the interest of the people is secured by explaining to them how disease may be avoided and life prolonged.

The formula must be plain, the rules simple and the expense not out of proportion to the results obtainable.

The various methods employed in the educational work in the Eure-et-Loir include newspaper articles, exhibits, posters, brochures and public meetings.

This feature of the departmental organization is now being developed intensively. Modern Health Crusaders are being organized in the schools and the educational division is coöperating with the local authorities and the various relief committees in many ways. For example, ten thousand copies of the report of the special commission of the General Council dealing with various phases of the health problem are at present being printed at the expense of the Rockefeller Commission for distribution throughout France.

COSTS

A conservative estimate of the value of the real estate and buildings placed at the disposition of the Commission for the 24 dispensaries is $50,000. The expense of new construction, adaptation of existing buildings and installation for dispensary purposes has amounted to $55,000. Real estate and buildings to the value of $91,000 have been given over for hospital purposes and the cost of new construction, remodelling of existing buildings and installation will amount to $120,000, exclusive of the departmental sanatorium, the buildings and site of which will represent an expenditure of approximately $250,000.

The sum of approximately $566,000 may therefore be said to represent the capital expenditure for the dispensaries, hospitals, day-camp and sanatorium and constitutes the combined contributions of the various departmental organizations, the American Red Cross and the Commission. Of the above mentioned sum, slightly less than 13 per cent was contributed by the Rockefeller Commission.

Based on a population of 275,000 the total capital expenditure amounts to slightly more than $2.00 per inhabitant. The work, however, was

undertaken at a time when both labor and material were not only expensive but also very difficult to obtain at any price. Furthermore the most expensive type of construction for the sanatorium (about $2000 per bed) was voted by the General Council and this amount represents nearly one-half of the total capital expenditure for all purposes. In this connection it should be added that the type of construction in France is generally more substantial and expensive than we use in the United States.

MAINTENANCE

The annual expense for maintenance of the 157 hospital beds (based on war prices) will amount to approximately $50,000 or about 18 cents per year per inhabitant. The annual maintenance for the 100 sanatorium beds (also based on war prices), will approximate $52,000 or about 19 cents per year per inhabitant.

With regard to the dispensary system, its organization under war conditions necessitated a great deal of expense for automobile transportation, American medical personnel, departmental business, office, etc., that is now being rapidly eliminated and the annual operating expenses for the 4 central and 20 branch dispensaries, exclusive of physicians salaries, will not exceed $40,000.

All items such as rent, heat, light, repairs and renewals, printing and stationery, office and general expenses, drugs and medical supplies, X-ray service (fluoroscopy only), laboratory, etc., have been included. This estimate is based upon the actual maintenance figures for the past year and provides for a nursing staff of 4 supervisors at 500 francs per month and 14 *visiteuses d'hygiene* at 300 francs per month in addition to the requisite technical personnel for the departmental laboratory.

The maintenance of the dispensary feature of the Commission's program will therefore amount to approximately 14½ cents per year, per inhabitant.

It should be stated that funds for relief purposes have not been included in these calculations as relief accounts cannot be properly charged against dispensary maintenance.

GENERAL REMARKS

The plans for the departmental organization were worked out in advance in considerable detail particularly from the standpoint of assuring its establishment upon a basis that would be economically sound, the

consideration of all public problems from this point of view being fundamental.

It had been considered originally that a rather elaborate system of ambulant dispensaries would be required as an important feature of the departmental organization, but careful study of the proportion of the population to be reached in this manner, the tuberculosis mortality rate of this group and the expense involved showed conclusively that at least under existing conditions and for the present the cost of operation would be out of all proportion to the value of the results that might be obtained.

The generally accepted principle of centralization of control and decentralization of operation was adhered to with most satisfactory results. Upon this and upon the standardization of dispensary plans, equipment, records, method and procedure, etc., was placed the greatest emphasis from the standpoint of their fundamental value and importance.

In at least one rural department of France the rôle of the dispensary as the centre of the tuberculosis activities has been demonstrated to be economically feasible and the proportion of the population not reached by the present dispensary system does not exceed 15 per cent of the total.

In considering the application and extension of the Eure-et-Loir organization to the other departments of France, the "unit of organization" for dispensaries should be the arrondissement rather than the canton until such time as the country is provided with an adequate dispensary system everywhere. From the standpoint of a theoretical program for the control of tuberculosis it is an easy matter to arrive at a comparatively accurate estimate of the number of hospital, sanatorium and preventorium beds required; but the number of dispensaries needed cannot be arrived at with the same degree of facility or accuracy nor by the same methods, at least as far as rural departments are concerned. No "rule of thumb," based on population and mortality statistics, can be applied here and the number of dispensaries required can only be determined after careful study and consideration of such additional factors as density of population, transportation facilities, etc.

The experience of the Commission in the Eure-et-Loir has demonstrated the necessity of having the medical staff on a permanent basis, as a service of rotation is most unsatisfactory both from the standpoint of dispensary operation and also of administration. The success and usefulness of any dispensary depends almost entirely upon the quality of the service which it provides; and this applies to both the medical and the nursing personnel. The nurses have been given a uniform course of instruction embracing both tuberculosis and infant welfare and the special instruc-

tion given the local department physicians is to be made available for the doctors in the provinces. In this connection, it should be made clear that this instruction relates primarily to dispensary method and procedure rather than to the clinical and scientific aspects of the tuberculosis problem. The ultimate use of the dispensaries for general medical clinics is a development which is highly desirable.

From the standpoint of the physicians in the provinces there is reason to believe that their connection with the dispensary service on a non-salaried basis would be amply compensated by the increased revenue from patients able to pay for their professional services who would consult them because of their dispensary affiliation. Nevertheless it must be admitted that from the standpoint of administrative control there is much to be said in favor of paying the physicians at least a small fee for their dispensary work.

The fact that laundry facilities were not established as an integral part of the Eure-et-Loir dispensaries has been commented upon by some of our French confreres, who feel that the actual danger from the patients' linen is such as to warrant the expense of laundry installations. The Commission does not share this point of view. However, for entirely different reasons such as the promotion of cleanliness and economy in laundry bills (which are frequently an important item in the budget of relief committees), the installation of laundry facilities and also shower baths in certain of the larger dispensaries might be considered.

The arrangement of having a separate day for the children's consultations is a detail deserving of special mention and the use of stereoscopic plates for all chest pictures is an innovation which has been very cordially received by our French colleagues.

With reference to the dispensary laboratories it is the plan of the Commission to give them over to the hospitals in which they are located and to coöperate with the General Council in the establishment of a central laboratory at Chartres, which will serve the entire department.

An important result of the work in the Eure-et-Loir and elsewhere has been the demonstration of the great value of American methods of publicity applied to French conditions. The demonstration organization is also serving to make known in France American dispensary methods and procedure and is thus contributing in a small way toward a closer medical rapprochement between the two nations. Most important, however, from every point of view, has been the demonstration on the part of the French in the Eure-et-Loir and also in the other departments of France of a keen desire and an extraordinary ability to do things for themselves.

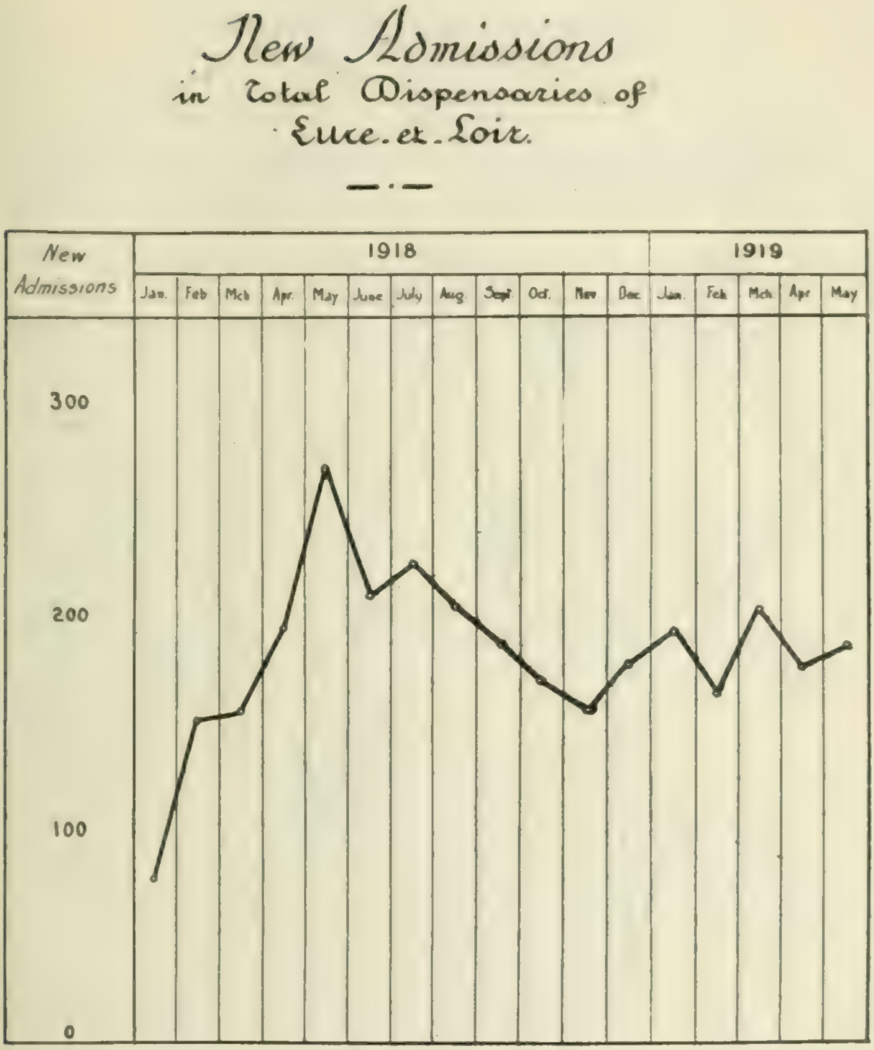
New Admissions
in Total Dispensaries of
Eure-et-Loir.
New Admissions
1918
1919
Jan.
Feb
Mch
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan.
Feb.
Mch.
Apr
May
300
200
100
0

CHART 1

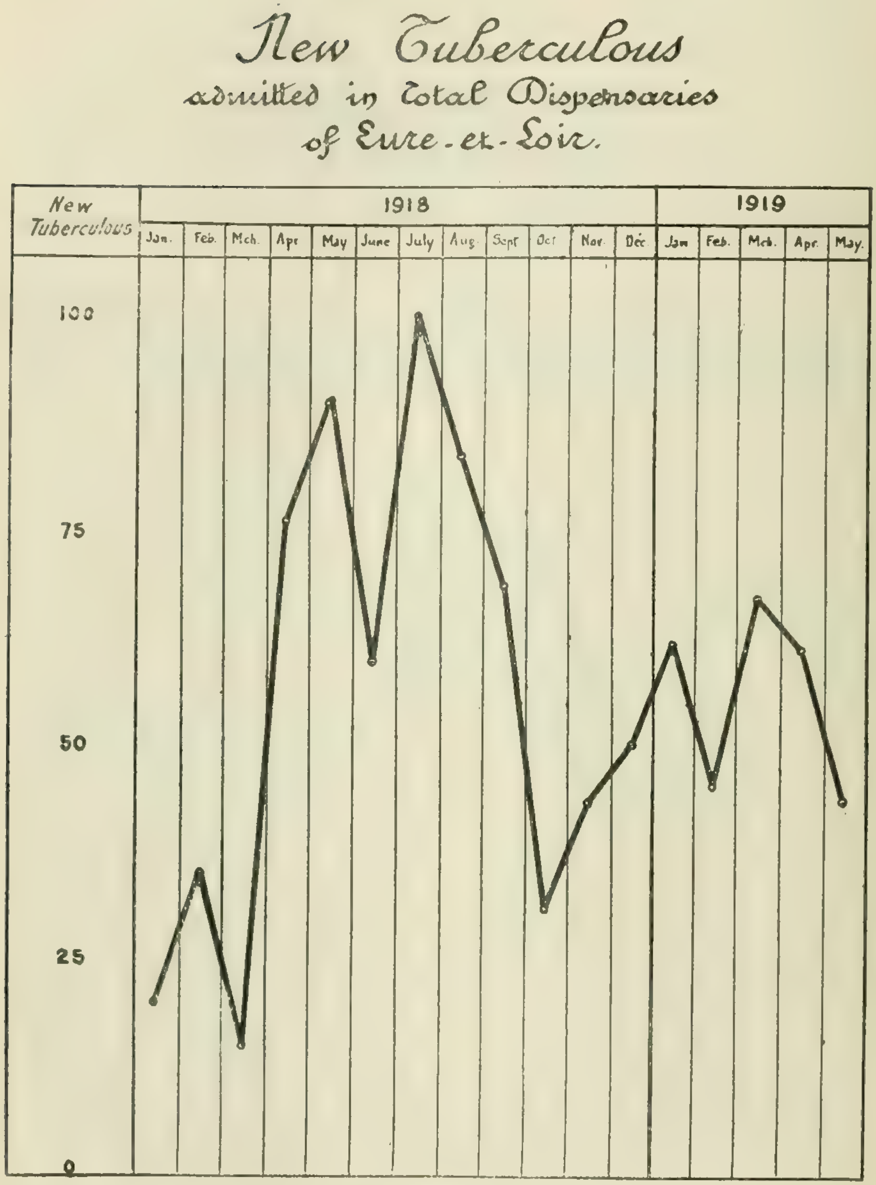
New Tuberculous
admitted in Total Dispensaries
of Eure-et-Loir.
New Tuberculous
1918
1919
Jan.
Feb.
Mch.
Apr
May
June
July
Aug.
Sept
Oct
Nov.
Dec.
Jan
Feb.
Mch.
Apr.
May.
100
75
50
25
0

Chart 2

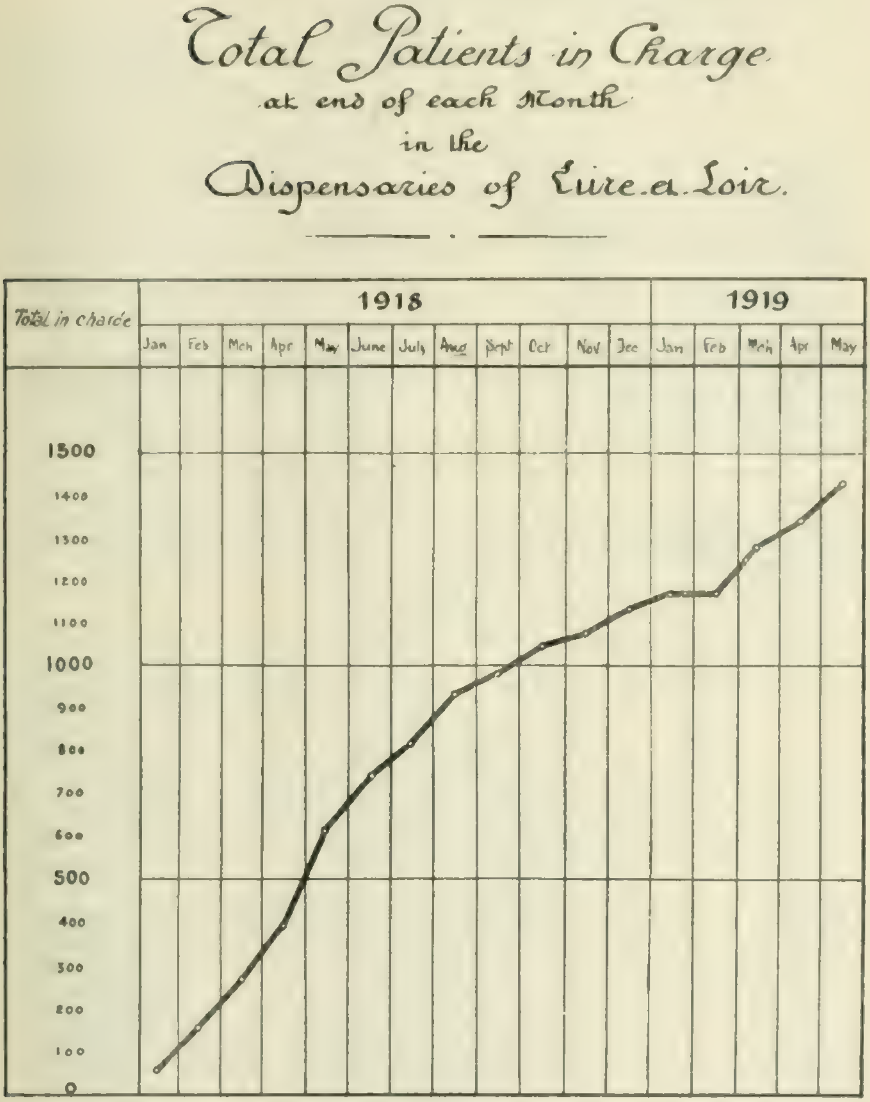
Total Patients in Charge
at end of each Month
in the
Dispensaries of Eure-et-Loir.
Total in charge
1918
1919
Jan
Feb
Mch
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mch
Apr
May
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0

CHART 3

TABLE 1

Total number of admissions, October, 1917, to December, 1918

DISPENSARIES AND PERIOD OF WORK	MEN		WOMEN		CHILDREN UNDER SIXTEEN		TOTAL ADMISSIONS
	Number	Per cent	Number	Per cent	Number	Per cent	
"Pont-de-Flandre" (opened October, 1917)	469	15.8	1390	46.7	1115	37.5	2974
"Amerique" (opened February, 1918)	249	18.7	791	59.5	289	21.8	1329
"Combat" (opened July, 1918)	100	17.7	318	56.2	148	26.1	566
Total admissions in Paris	818	16.8	2499	51.3	1552	31.9	4869
Chartres (opened January, 1918)	148	20.4	272	37.6	304	42.0	724
Chateaudun (opened March, 1918)	126	24.9	215	42.4	166	32.7	507
Dreux (opened January, 1918)	142	19.7	268	37.2	310	43.1	720
St. Remy (opened May, 1918)	34	19.1	79	44.4	65	36.5	178
Nogent-le-Rotrou (opened November, 1918)†††	14	25.5	21	38.1	20	36.4	55
Total admissions in Eure-et-Loir	465	21.3	855	39.1	865	39.6	2184
Total number of admissions	1282	18.2	3354	47.6	2417	34.2	7053

TABLE 2

Number of tuberculous among patients admitted to clinics

DISPENSARIES	MEN			WOMEN			CHILDREN UNDER SIXTEEN			TOTAL		
	Total admissions	Found tuberculous	Per cent tuberculous	Total admissions	Found tuberculous	Per cent tuberculous	Total admissions	Found tuberculous	Per cent tuberculous	Total admissions	Found tuberculous	Per cent tuberculous
"Pont-de-Flandre"	469	249	53.1	1390	559	40.2	1115	73	6.5	2974	881	29.6
"Amerique"	249	128	51.4	791	265	33.5	289	12	4.2	1329	405	30.5
"Combat"	100	71	71.0	318	143	45.0	148	29	19.6	566	243	42.9
Total in Paris	818	448	54.8	2499	967	38.8	1552	114	7.3	4869	1529	31.4
Chartres	148	79	53.4	272	107	39.3	304	50	16.4	724	236	32.6
Chateaudun	126	68	54.0	215	81	37.7	166	26	15.7	507	175	34.5
Dreux	142	69	48.6	268	94	35.1	310	30	9.7	720	193	26.8
St. Remy-sur-Avre	34	22	64.7	79	28	35.4	65	7	10.8	178	57	32.0
Nogent-le-Rotrou	14	4	28.6	21	6	28.7	20	2	10.0	55	12	21.8
Total in Eure-et-Loir	464	242	52.1	855	316	37.0	865	115	13.3	2184	673	30.8
Total tuberculous among patients admitted	1282	690	53.8	3354	1283	38.2	2417	229	9.4	7053	2202	31.1

TABLE 3

Classification of the total number found tuberculous; men, women and children

DISPENSARIES	MEN		WOMEN		CHILDREN UNDER SIXTEEN		TOTAL
	Number	Per cent	Number	Per cent	Number	Per cent	
"Pont-de-Flandre"	249	28.3	559	63.4	73	8.3	881
"Amerique	128	31.6	265	65.4	12	3.0	405
"Combat"	71	29.3	143	58.8	29	11.9	243
Total in Paris	448	29.3	967	63.2	114	7.5	1529
Chartres	79	33.5	107	45.3	50	21.2	236
Chateaudun	68	38.9	81	46.3	26	14.8	175
Dreux	69	35.8	94	48.7	30	15.5	193
St. Remy	22	38.6	28	49.1	7	12.3	57
Nogent-le-Rotrou	4	33.3	6	50.0	2	16.7	12
Total in Eure-et-Loir	242	36.0	316	46.0	115	17.0	673
Total	690	31.3	1283	58.3	229	10.4	2202

TABLE 4

Diagnosis and stage of the disease on admission

DISPENSARIES	INCIPIENT		MODERATELY ADVANCED		FAR ADVANCED		OTHER FORMS OF TUBERCULOSIS	TOTAL DISCHARGED TUBERCULOUS
	Open lesion	Close lesion	Open lesion	Close lesion	Open lesion	Close lesion		
"Pont-de-Flandre"	25	292	50	120	36	48	36	607
"Amerique"	44	74	37	17	17	9	2	200
"Combat"	15	35	22	22	13	12	4	123
Total for Paris	84	401	109	159	66	69	42	930
	9.1%	43.1%	11.7%	17.1%	7.1%	7.4%	4.5%	100%
	485 or 52.2%		268 or 28.8%		135 or 14.5%			
Chartres	1	11	11	19	9	12	9	72
Chateaudun	3	15	11	4	6	9	3	51
Dreux	16	27	15	13	10	10	7	98
St. Remy-sur-Avre	5	5	1	5	0	3	1	20
Nogent-le-Rotrou	0	0	0	1	0	0	0	1
Total for Eure-et-Loir	25	58	38	42	25	34	20	242
	10.3%	24.0%	15.7%	17.4%	10.3%	13.6%	8.7%	100%
	83 or 34.0%		80 or 33.0%		59 or 24.3%			
	109	459	147	201	91	103		
	9.3%	39.2%	12.5%	17.1%	7.8%	8.8%		
	568 or 48.5%		348 or 29.7%		194 or 16.5%		62 or 5.3%	1172 100%

TABLE 5

Total clinic sessions held and average attendance at clinic sessions

DISPENSARIES	CLINIC SESSIONS HELD	ATTENDANCE AT SESSIONS: Men		Women		Children under sixteen		TOTAL	
		Attendance	Average	Attendance	Average	Attendance	Average	Attendance	Average
"Pont-de-Flandre"	299	1,840	6	5,330	18	3,444	12	10,614	36
"Amerique"	159	1,146	7	3,401	21	1,080	7	5,627	35
"Combat"	98	743	8	2,307	24	636	6	3,686	38
Total in Paris	556	3,729	7	11,038	20	5,160	9	19 927	36
Chartres	114	430	4	843	7	767	7	2,040	18
Chateaudun	110	489	4	711	7	415	4	1,609	15
Dreux	135	466	3	752	6	872	6	2,090	15
St. Remy	32	132	5	260	8	204	6	596	19
Nogent-le-Rotrou	9	27	3	31	4	21	2	79	9
Total in Eure-et-Loir	400	1,544	4	2,591	6	2,279	6	6,414	16
Total sessions and average attendance	900	5,273	6	13,629	15	7,439	8	26,341	29

TABLE 6

Result of treatment taken on 1172 tuberculous patients discharged from clinics (October, 1917, to December 31, 1918)

	PULMONARY TUBERCULOSIS			TUBERCULOSIS, OTHER FORMS	TOTAL FOR PARIS		PULMONARY TUBERCULOSIS			TUBERCULOSIS, OTHER FORMS	TOTAL FOR EURE-ET-LOIR		GRAND TOTAL	
	Incipient	Moderately advanced	Far advanced		Number	Per cent	Incipient	Moderately advanced	Far advanced		Number	Per cent	Number	Per cent
Died	14	25	26	2	67	7.2	5	23	24	5	57	23.6	124	10.6
Progressive	71	74	35	5	185	19.9	9	17	10	0	36	14.9	221	18.8
Stationary	333	145	69	31	578	62.2	40	34	24	13	111	45.8	689	58.9
Improved	64	23	5	4	96	10.3	25	6	0	1	32	13.2	128	10.9
Quiescent	0	0	0	0	0		0	0	0	0	0		0	
Apparently arrested	1	0	0	0	1	0.1	3	0	1	0	4	1.7	5	0.4
Definite arrest	2	1	0	0	3	0.3	1	0	0	1	2	0.8	5	0.4
Apparently cured	0	0	0	0	0		0	0	0	0	0		0	
Total	485	268	135	42	930	100	83	80	59	20	242	100	1172	100

TABLE 7

Report on the discharged cases

DISPENSARIES	TOTAL DIS-CHARGED	DISCHARGED TUBERCULOUS								DISCHARGED NON-TUBERCULOUS							
		Men		Women		Children under sixteen		Total dis-charged tuberculous		Men		Women		Children under sixteen		Total dis-charged non-tuberculous	
		Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent
"Pont-de-Flandre"	2128	162	25.7	378	62.3	67	11.0	607	28.5	148	9.7	617	40.6	756	49.7	1521	71.5
"Amerique"	907	62	31.0	122	61.0	16	8.0	200	22.1	98	13.9	431	61.0	178	25.1	707	77.9
"Combat"	343	37	30.1	74	60.1	12	9.8	123	35.9	34	15.4	128	58.2	58	26.4	220	64.1
Total for Paris	3378	261	28.1	574	61.7	95	10.2	930	27.5	280	11.4	1176	48.1	992	40.5	2448	72.5
Chartres	364	21	29.2	38	52.8	13	18.0	72	19.8	42	14.4	106	36.3	144	49.3	292	80.2
Chateaudun	200	22	43.1	25	49.1	4	7.8	51	25.5	39	26.2	58	38.9	52	34.9	149	74.5
Dreux	454	41	41.8	43	43.9	14	14.3	98	21.6	67	18.8	123	34.6	166	46.6	356	78.4
St. Remy	86	9	45.0	6	30.0	5	25.0	20	23.3	12	18.2	30	45.4	24	36.4	66	76.7
Nogent-le-Rotrou	2	0		1	100.0	0		1	50.0	0		1	100.0	0		1	50.0
Total for Eure-et-Loir	1106	93	38.4	113	46.7	36	14.9	242	21.9	160	18.5	318	36.8	386	44.7	864	78.1
Grand total	4484	354	30.2	687	58.6	131	11.2	1172	26.1	440	13.3	1494	45.1	1378	41.6	3312	73.9

TABLE 8

Reasons for discharge

DISPENSARIES	NOT TUBERCULOUS		LEFT CITY		UNTRACED		SENT TO HOSPITAL		ARRESTED		IN OTHER CARE		DIED		MOVED		REFUSED TREATMENT		TOTAL DISCHARGED CASES
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	
"Pont-de-Flandre"	1149	54.0	200	9.4	47	2.2	367	17.2	3	0.2	30	1.4	43	2.0	43	2.0	246	11.6	2128
"Amerique"	622	68.6	64	7.1	0		129	14.2	1	0.1	53	5.8	23	2.5	0		15	1.7	907
"Combat"	187	54.5	21	6.1	1	0.3	69	20.1	2	0.6	0		17	5.0	9	2.6	37	10.8	343
Total for Paris	1958	58.0	285	8.4	48	1.4	565	16.7	6	0.2	83	2.5	83	2.5	52	1.5	298	8.8	3378
Chartres	249	68.4	38	10.4	11	3.1	38	10.4	0		7	1.9	16	4.4	1	0.3	4	1.1	364
Chateaudun	118	59.0	37	18.5	3	1.5	3	1.5	0		0		29	14.5	0		10	5.0	200
Dreux	310	68.3	49	10.8	11	2.4	46	10.1	3	0.7	1	0.2	14	3.1	1	0.2	19	4.2	454
St. Remy-sur-Avre	59	68.6	8	9.3	1	1.2	11	12.8	2	2.3	0		3	3.4	1	1.2	1	1.2	86
Nogent-le-Rotrou	0		2	100.0	0		0		0		0		0		0		0		2
Total for Eure-et-Loir	736	66.5	134	12.1	26	2.4	98	8.9	5	0.4	8	1.7	62	5.6	3	0.3	34	3.1	1106
General total	2694	60.1	419	9.3	74	1 7	663	14.8	11	0.2	91	2.1	145	3.2	55	1.2	332	7.4	4484

TABLE 9

Length of attendance at dispensaries of discharged cases

DISPENSARIES	PATIENTS WHO ATTENDED ONCE		FROM TWO DAYS TO 29 DAYS		FROM ONE MONTH TO THREE MONTHS		FROM THREE MONTHS TO SIX MONTHS		FROM SIX MONTHS TO ONE YEAR		TOTAL DISCHARGED CASES
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	
"Pont-de-Flandre"	932	43.8	525	24.7	419	19.7	188	8.8	64	3.0	2128
"Amerique"	353	38.9	312	34.4	162	17.9	65	7.2	15	1.6	907
"Combat"	116	33.8	108	31.5	78	22.7	25	7.3	16	4.7	343
Total for Paris	1401	41.5	945	28.0	659	19.5	278	8.2	95	2.8	3378
Chartres	121	33.2	98	26.9	84	23.1	45	12.4	16	4.4	364
Chateaudun	90	45.0	65	32.5	35	17.5	10	5.0	0		200
Dreux	94	20.7	99	21.8	125	27.5	110	24.2	26	5.8	454
St. Remy-sur-Avre	27	31.4	13	15.1	25	29.1	19	22.1	2	2.3	86
Nogent-le-Rotrou	2	100	0		0		0		0		2
Total for Eure-et-Loir	334	30.2	275	24.9	269	24.3	184	16.6	44	4.0	1106
General total	1735	38.7	1220	27.0	928	20.8	462	10.4	139	3.1	4484

TABLE 10

Sex and age of the tuberculous patients discharged from clinics

DISPENSARIES	UNDER TEN		FROM TEN TO SIXTEEN		FOM SIXTEEN TO NINETEEN		FROM TWENTY TO TWENTY-NINE		FROM THIRTY TO THIRTY-NINE		FROM FORTY TO FORTY-NINE		FROM FIFTY TO FIFTY-NINE		FROM SIXTY AND OVER		TOTAL DISCHARGED TUBERCULOUS		
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	General total
"Pont-de-Flandre"	13	17	11	26	22	43	25	112	44	118	41	60	22	23	8	22	186	421	607
"Amerique"	1	2	8	5	6	10	15	33	13	36	9	26	14	11	5	6	71	129	200
"Combat"	0	4	4	4	4	5	5	24	14	25	5	7	7	8	2	5	41	82	123
Total for Paris	14	23	23	35	32	58	45	169	71	179	55	93	43	42	15	33	298	632	930
	31 =4.0%		58 =6.2%		90 =9.7%		214 =23.0%		250 =26.9%		148 =15.9%		85 =9.1%		48 =5.2%		32%	68%	
Chartres	1	4	3	5	5	3	2	12	7	15	2	6	4	2	1	0	25	47	72
Chateaudun	1	0	1	2	2	2	3	8	7	10	5	4	4	0	1	0	24	27	51
Dreux	3	0	6	5	2	6	12	14	14	12	5	6	4	2	4	3	50	48	98
St. Remy-sur-Avre	1	0	0	4	1	1	2	3	0	1	3	1	3	0	0	0	10	10	20
Nogent-le-Rotrou	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1
Total for Eure-et-Loir	6	4	10	16	10	12	19	38	28	39	15	17	15	4	6	3	109	133	242
	10 =4.1%		26 =10.7%		22 =9.1%		57 =23.6%		67 =27.7%		32 =13.2%		19 =7.9%		9 =3.7%		45.1 %	54.9 %	
Grand total	20	27	33	51	42	70	64	207	99	218	70	110	58	46	21	36	407	765	1172
	47 =4.0%		84 =7.2%		112 =9.5%		271 =23.1%		317 =27.0%		180 =15.4%		104 =8.9%		57 =5.0%		34.8 %	56.2 %	

TABLE 11

Report on work of nurses of Rockefeller Commission in France; Commission's dispensaries (October, 1917, to December 31, 1918)

DISPENSARIES	NURSES' WORK							HOURS OF WORK								
	Home visits		Visits elsewhere*	Total visits	Patients seen		Consultations attended	At the clinic		Visiting		Clerical and office work		Miscellaneous		Total hours of work
	Inquiry and inspection	To bed-ridden			Inquiry and inspection	Bed-ridden†		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	
Paris (XIXth Arrt.)																
"Pont-de-Flandre"	9,268	30	636	9,934	6,630	193	2,129	8,384	42.8	4,914	25.1	5,009	25.5	1,292	6.6	19,599
"Amerique"	5,254	33	405	5,692	3,748	383	1,188	4,063	38.1	2,452	23.0	3,847	36.0	311	2.9	10,673
"Combat"	3,169	23	175	3,367	2,058	372	615	615	36.3	1,679	25.0	2,400	35.7	203	3.0	6,728
Total	17,691	86	1,216	18,993	12,436	948	3,932	14,893	40.3	9,045	24.4	11,256	30.4	1,806	4.9	37,000
Eure-et-Loir																
Chartres	2,051	63	447	2,561	1,405	230	233	862	21.2	1,691	41.6	1,511	37.2	0		4,060
Chateaudun	1,147	79	551	1,777	1,090	240	292	1,307	26.2	980	19.7	2,346	47.1	348	7.0	4,981
Dreux	2,046	162	588	2,796	1,678	183	298	1,220	29.5	1,249	30.2	1,562	37.9	101	2.4	4,132
St. Remy-sur-Avre	827	103	377	1,307	832	125	50	196	14.4	572	42.1	591	43.5	0		1,359
Nogent-le-Rotrou	47	0	138	185	149	21	14	59	12.8	125	27.0	278	60.2	0		462
Total	6,118	407	2,101	8,626	5,154	799	887	3,641	24.3	4,617	30.8	6,288	41.9	449	3.0	14,998
Total commission	23,809	493	3,317	27,619	17,590	1,747	4,819	18,537	35.7	13,662	26.3	17,544	33.7	2,255	4.3	51,998

* Including visits to hospitals.

† Including patients seen in hospitals.

REPORT ON THE TUBERCULOSIS SITUATION IN GERMANY[1]

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An investigation of the tuberculosis situation in Germany, particularly in the area occupied by the American Army, was undertaken for two principal reasons: first and most important, to determine its bearing on the German food shortage, and second, to study its relation to the health conditions of our troops. If tuberculosis was increasing in the degree claimed we would naturally seek as causes increased opportunities for infection and factors lowering the health and nutritional standard of the people. As this disease is influenced greatly in its clinical development and course by nourishment, an increase in its morbidity and mortality would have a direct bearing on the question of the humane necessity of feeding the German population. As suggested in the final report (1) of the Senior Consultant in Tuberculosis for the A. E. F., that possibly some of our soldiers dying of tuberculosis had been infected in France, a wide prevalence of tuberculosis in the area occupied by our troops in Germany might necessitate special measures to prevent such infection. However, upon careful analysis of the incidence of tuberculosis in the A. E. F., it is not believed that there are sufficient grounds to base such a conclusion. With perhaps rare exceptions, soldiers dying of tuberculosis showed old lesions, and they succumbed to a disease which they brought with them when they arrived in Europe.

THE TUBERCULOSIS SITUATION IN GERMANY BEFORE THE WAR

As compared with other countries (2) Germany had a low death rate from tuberculosis before the war (charts 1 and 2). Whether this was due to the better housing and living conditions of the poor, to a more perfect immunity possessed by the German nationality against this disease or to their method of combating it, is difficult to say. It is,

[1] From the office of the Civil Governor, American Area, Department of Sanitation and Public Health, Trier, Germany, May 20, 1919.

however, true that for a number of years they had been carrying on an active campaign against tuberculosis, probably more so than any other country, and those interested in this pointed with great pride to the yearly reduced mortality rate and cited this reduction as a proof of the efficacy of their work. It is to be assumed that a nation which had discovered the cause of the disease, which had proved its infectiousness and had made many valuable investigations concerning its etiology, would naturally take an added interest in its prevention.

In Germany, as in all other countries, tuberculosis had been recognized as the most widespread and deadly of diseases. During peace times the yearly death rate for tuberculosis in Germany was in round numbers 100,000 and it has been stated that about a third of the people between the ages of sixteen and sixty died of this disease. The great necessity of combating tuberculosis having become recognized and the preventive measures made clear by the discovery of the tubercle bacillus, it only required the excellent machinery of the German public health system to make the antituberculosis campaign successful. Thus in Prussia before the war the tuberculosis mortality rate had gradually fallen from 207.1 per 100,000 in 1899 to 136.5 per 100,000 in 1913 (chart 3) (3).

THE TUBERCULOSIS SITUATION IN GERMANY DURING THE WAR

In undertaking the study of the tuberculosis situation in Germany during the war we would expect to find that this disease had increased. Even without our investigation we could assume this to be a fact, for the severe strain which such a prolonged struggle places on the lives of a people will always lead to an increase in tuberculosis. Available reports from other countries involved in the war from the very beginning show an augmented mortality rate. In England compared with 1913 there was an increase of 1582 deaths in 1914, of 4521 in 1915, of 4490 in 1916 and of 6058 in 1917 resulting from tuberculosis (4).

In Germany tuberculosis is not a reportable disease and, as it is difficult to estimate the number of living cases, for most of our statistics we must consult mortality reports. It has been authoritatively stated that the tuberculosis mortality rate in Germany is back to where it was twenty years ago. In 1899 the death rate per 100,000 for tuberculosis in Prussia was 207.1. By 1913 it had been reduced to 136.5, and now at the end of 1918 we find it has increased again to 240.4 (chart 3). While the increase was noted at the end of the first year of the war, it was more marked during the last two years.

Tuberculosis death rate per 100,000 inhabitants Prussia

1899..... 207.1	1904...... 192.1	1909..... 155.9	1914..... 138.7
1900..... 211.3	1905...... 191.3	1910..... 152.9	1915..... 144.5
1901..... 195.4	1906...... 172.6	1911..... 151.2	1916..... 163.8
1902..... 190.4	1907...... 171.6	1912..... 145.8	1917..... 215.5
1903..... 197.0	1908...... 164.6	1913..... 136.5	1918..... 240.4

The marked increase during the last two years is also noticeable when we come to consider the provinces, districts, cities and towns of Prussia separately. Dr. Hamel, *Medizinal Referent* of the Imperial Ministry of the Interior, reported (5) at a special session of Medical Societies in Berlin on December 18, 1918, that throughout Prussia in the cities of over 15,000 inhabitants there died of tuberculosis in 1913 40,144, while in the first half year of 1918 41,800 died in these cities from the same cause. Many striking figures may be cited. For instance, at the same meeting it was stated by other authorities that in Stettin deaths from tuberculosis for the ages of from one to fifteen have increased from 0.35 per cent in 1910 to 0.94 per cent in 1918. In Hamburg in the year 1917, 48.5 per cent and in 1918 53 per cent more people died from tuberculosis than in the preceding years of the war or during the peace years from 1909 to 1913. In the country district of Bonn, for all ages the death rate increased from 98 in 1912 to 190 in 1918. In the city of Cologne the deaths from all forms of tuberculosis have increased from 916 in 1913 to 2184 in 1918 and during the first four months in 1919, 951 deaths had already occurred (chart 4). In the region (*Regierungsbezirk*) of Trier, the increase has been from 149.1 per 100,000 in 1913 to 267.5 per 100,000 in 1918 (chart 9) and in that of Coblenz, 159 in 1913 to 200.2 in 1918 (chart 9). This increase is a common observation of all physicians. They see more cases in their practice whether they be clinicians, surgeons or pediatricians. More cases are being admitted to the hospitals; the tuberculosis sanatoria are filled; and the tuberculosis dispensaries have many more patients under supervision. The association in Breslau for the care of indigent comsumptives reports the following consultations given in their "Office for Information and Treatment:"

1913–1914....................................	8,692 patients with 2906 cases
1917–1918....................................	20 669 patients with 4277 cases

The number of patients had therefore doubled and the number of new cases had increased almost 50 per cent. At the tuberculosis dispensary in Cologne, the number of tuberculous families under super-

vision increased from 2070 in 1913 to 3122 in 1917 and the number of patients sent to sanatoria, to the country and convalescent homes, increased from 811 in 1913 to 2017 in 1917 (7). All forms of tuberculosis have increased. In the surgical clinic of the Lindenburg Hospital, Cologne, 90 cases of surgical tuberculosis (tuberculosis of lymph glands, bones, joints, etc.), or 4.3 per cent of the entire number (2055) of surgical cases, were treated in 1911, and 252, or 10.8 per cent of the entire number (2314), were treated in 1918 (8).

Scrofula in children throughout the whole of Germany is said to have increased 30 per cent during the last two years. In Kiel, the city school physician found among 30,000 students of the public schools in 1914, 800 and in 1918, 6500 cases of pronounced scrofula (9). Professor Noeggerath reports that the deaths from all forms of tuberculosis among the children of the cities of Baden have increased from 190 in 1913 to 262 in 1917 (10).

TUBERCULOSIS IN THE GERMAN ARMY

The incidence of tuberculosis in the German Army before the war had been steadily decreasing, in conformity with the steady fall in the death rate from this disease in the civil population. The following table shows the percentage incidence, per 1000, of tuberculosis in the German Army during peace times.

YEAR November 1 to October 30	TOTAL CASES	PERCENTAGE
1908–1909	950	1.7
1909–1910	1027	1.9
1910–1911	1007	1.8
1910–1912	1026	1.8
1912–1913	1036	1.8

These figures do not include Bavaria, the statistics for which are not available owing to unsettled political conditions in Munich, but for practical purposes the Bavarian figures may be disregarded as they only represent three out of twenty-four army corps; that is to say, one-eighth of the total; moreover the Berlin authorities are positive that they tally with those given above.

This low tuberculosis rate is attributed to the decrease of tuberculosis in the civil population, to careful physical examinations and the following up of every soldier with a cough until proved nontuberculous.

In peace times, Germany was able to choose from a number of recruits far in excess of the actual needs of the standing army: consequently every man showing positive or even remotely suspicious signs of tuberculosis, including the inactive forms, was rejected. With the advent of the war this policy was altered, especially as the enemy countries increased and it became apparent that the war was to be prolonged. Man power became essential and many tuberculous subjects, that is, those with arrested lesions were accepted for military service.

The following instructions were published March 2, 1916, similar to orders issued previously:

> The following general points should be used as a guide in judging the fitness of tuberculous subjects, for military service under war conditions.
>
> 1. The efficiency of the man, measured by the efficiency of the labor or occupation he would still be capable of performing in civil life.
>
> 2. The danger of propagating the disease through the dissemination of bacilli.
>
> 3. The probability (not the possibility, which is always present under war conditions) of an aggravation of the disease by military service, with consequent ineffectiveness.
>
> Accordingly, every case of open tuberculosis, recognizable as such by positive sputum findings or by clinical signs, excludes war service; the same also applies to prolonged fever caused by the process.
>
> Generally speaking, a progressive or not yet arrested (active) tuberculosis means unfitness for war service. Whether this unfitness is permanent or a cause of discharge from the army, or only temporary and justifying retention in the service for a period of observation, can only be decided in each separate case by a careful examination, and taking into consideration all the circumstances.
>
> An inactive, arrested tuberculosis even if manifest, that is to say, confirmed by findings of a physical examination including the X-ray, does not necessarily exclude fitness for war service.
>
> The general nutrition, the condition of the muscles of the heart and other organs, and the former occupation in civil life are to be taken into consideration when deciding upon the nature of the duty the man is to perform.

No statistics are available to show the number of soldiers enlisted under these conditions who later developed active tuberculosis. It was found in many instances however that men with arrested lesions did well in the field and a number of special cases are reported in which soldiers with large arrested lesions and even with active tuberculosis improved in the army. Autopsies made in field hospitals often showed

healed lesions which had remained quiescent in spite of the hardships of active warfare.

During the first year of the war, the physical examinations were conducted by inexperienced medical officers, fresh from civil life. In consequence many active cases of tuberculosis were accepted and the incidence of tuberculosis in the army increased so markedly that stringent measures had to be adopted. A more experienced medical personnel was placed in charge of all physical examinations and specific instructions issued for the guidance of medical examiners. The result was very satisfactory as the tuberculosis rate rapidly decreased. However during the last year, due to the prolongation of the strain, to greater activities and to less nutritious food, the rate increased again in the field army.

Incidence of tuberculosis in the German Army during the war

YEAR August 1 to July 31		FIELD ARMY		HOME FORCES		TOTAL	
		Cases	Per cent M. S.	Cases	Per cent M. S.	Cases	Per cent M. S.
First	1914–1915	7,166	2.8	8,153	4.4	15,319	3.4
Second	1915–1906	6,865	1.7	9,176	3.6	16,041	2.4
Third	1916–1907	5,523	1.1	8,392	3.7	13,915	1.9
Fourth	1917–1908	3,929	7.8	8,322	3.0	10,251	1.4

In peace times, tuberculous soldiers were promptly discharged from the army and treated in civil sanatoria. During the war, several sanatoria were provided or designated for each army corps, excepting the 15th (barred for climatic reasons), where tuberculous soldiers were transferred to receive treatment for from one to one and a half years, in exceptional cases two years. At the end of this period, the patients are discharged and if not cured, given a pension. In considering tuberculosis statistics for the civil population, soldiers are not included (13).

GERMAN METHODS OF COMBATING TUBERCULOSIS

The German methods of controlling tuberculosis are along the same lines as those employed in other progressive countries. Sanatoria, recuperation resorts in the woods, vacation colonies, dispensaries, open air schools, educational campaigns and social welfare work have all been highly developed. It is said that as early as 1913 Germany had over 69,000 beds for consumptives in health resorts. The individual among the working classes who develops tuberculosis probably receives better treatment than in most countries. This is due to the government

sickness insurance which has been in existence since 1883 and which provides monetary assistance, medicines, and treatment in hospitals, sanatoria, health resorts, etc. Every employee with a salary of less than 4000 marks must carry this insurance, one-third of the premium being paid by the employer and two-thirds by the employee. In addition to this Germany has over 2000 dispensaries and every day new ones are being opened. The dispensary is the centre of almost all the tuberculosis campaign activities in a community. It carries on a practical work in all directions. Patients are examined, curable ones sent to sanatoria and the incurable to hospitals or suitable treatment is provided at home. By many measures, an endeavor is made to prevent house infection. The tuberculosis dispensaries at Cologne and Trier have been visited and closely studied. They have the same organization and are run on the same plan.

The one at Cologne is larger and more complete and a model institution of its kind. Located in a modern building, it consists of a number of large airy rooms in which are located the various departments—receiving, record, examining, X-ray and laboratory. Three doctors and sixteen visiting nurses are on duty at this dispensary. The city of Cologne is divided into sixteen districts and a visiting nurse assigned to each district. Patients are sent to the dispensary by their family physicians; or, if they come of their own accord, a written report is always made to the family physician who treats the case with the advice and assistance of the dispensary. In this way the good will of the practising physicians is maintained and no friction results. Careful records are kept and all cases are followed up by the visiting nurses. The examination consists of the ordinary physical examination, routine use of the fluoroscope, X-ray plates in certain cases, sputum examinations, and Pirquet tests in young children. Inquiries are made concerning the financial conditions of the patient and monetary assistance given. Through the visiting nurse the conditions of the home are ascertained and, if necessary, better living quarters are rented, extra and more nourishing food is secured and bedding, reclining chairs and sputum cups are provided. The necessary disinfection is carried out and the nurses make frequent visits to see that all instructions concerning treatment and prevention of infection are being observed. In addition to this all other members of the family are brought to the dispensary for examination. Treatment is provided in hospitals, sanatoria, convalescent and country homes; and while the parents are undergoing such treatment, the care of the children is looked after. This dispensary was established

in 1907. It is maintained entirely by the city. Professor Krautwiz (*Beigeordneter*), medical deputy to the burgomeister of Cologne, appears to be a very energetic and enthusiastic health official. It was stated that the success of this institution is largely due to his interest and efforts. The Augusta and Lindenburg Hospitals in Cologne have annexes with excellent facilities for the open air treatment of tuberculosis. The health department work of Cologne is highly developed and well organized, much more so than in any of the cities in the American area of occupation. This is to be expected however, as Cologne is one of the largest and richest cities in Germany.

In Trier the tuberculosis dispensary occupies several isolated rooms in a building used as a general clinic for the infant and child welfare and maternity work. The city health officer (*Kreisarzt*) holds two weekly consultation hours at the dispensary, when he examines and advises cases referred to him. Connected with the dispensary are six visiting nurses. This dispensary functions about the same as the one at Cologne.

Among the many activities in the campaign against tuberculosis, the forest schools in Germany are very commendable. These are open air schools in the forest, open during the summer months for scrofulous and anaemic children. The one near Trier is situated within easy walking distance of the city. The children go to school in the morning, taking their lunch with them and return home in the evening. Three courses of six weeks are given yearly. A systematic campaign of education has been carried on very extensively. Everything is done to enlighten the people concerning tuberculosis by distributing pamphlets, posting placards, giving lectures with magic lantern and motion pictures and by publishing articles in the daily papers. The German authorities, having recognized that the fight against tuberculosis must start in early youth and continue through life, on the basis of not only preventing infection but in improving the health and the powers of resistance of the individual, speak at length of their efforts in infant and child welfare work; inducing mothers to nurse their babies; providing extra nourishment and more nutritious food; sending anaemic and scrofulous children into the country; providing modern, well ventilated school buildings and improving the housing conditions of the poor people and the surroundings of the working man. Women play a large part in this work, being in charge of the administration side. It is a great organization which extends its activities into many fields:—care of infants, small children, school children, weak children, orphans, ille-

gitimate children, cripples, insane, dumb, blind, alcoholics and venereals, and correlates all similiar functions of the government insurance-offices, church, and charitable societies with that of its own.

Certain general health regulations exist relative to the control of tuberculosis. Deaths from tuberculosis must be reported to the police authorities who see that the proper disinfections are carried out and school teachers with open tuberculosis are not allowed to teach. In addition certain provinces or states have special regulations of their own. In Bayern, Sachsen, Würtemburg, Baden, Oldenburg, Thüringische States, Waldeck, Lübeck, Hamburg and Elsass-Lothringen, each change of a residence of a person suffering from advanced pulmonary or laryngeal tuberculosis, or, if the disinfection of the dwelling of a tuberculosis patient is considered necessary by the doctor, is reported to the police authorities. Furthermore in Bayern, Baden, Lübeck and Elsass-Lothringen if such a patient lives in an educational institution, a report is required. In Würtemburg, Baden, Lübeck and Elsass-Lothringen also, a report must be made if thepatient greatly endangers those around him in respect to his living conditions. In Hamburg and Lübeck, if he is actually connected with the handling of food and thereby endangers surrounding persons, the police must be notified. In Königreich, Sachsen, Lübeck and Elsass-Lothringen generally speaking, every case in private hospitals, orphan and poor asylums, lodging houses and boarding schools, is to be reported to the police authorities within three days. In Waldeck and Schwarzburg-Rudolfstadt all cases are to be reported in which bacilli are demonstrable: only the physician, however, is obliged to give notice to the police.

During the war, the campaign against tuberculosis has probably relaxed to a certain degree, due to self evident causes. The scarcity of doctors and nurses, the shortage of food, the absence of soap and the demand upon labor for other purposes, leading to the neglect of the cleanliness of dwellings and personal hygiene are some of the causes to be mentioned.

THE TUBERCULOSIS SITUATION IN THE AREA OCCUPIED BY THE AMERICAN ARMY BEFORE AND DURING THE WAR

The tuberculosis situation in the area occupied by the American army has received more careful study by the writer and the etiological factors of the disease will be considered from the view point of conditions in this part of Germany. The area occupied by the American army

comprises most of the Region (*Regierungsbezirk*) of Trier, and a part of the Region of Coblenz. In this area are two small cities of from 50,000 to 60,000 inhabitants each and many small towns and villages. The principal occupations are farming, wine growing and truck gardening, although there are some factories, coal mines and quarries. The conditions of large industrial centres therefore do not exist and all the people, even in the two small cities mentioned, are within easy access of the country. This area has a civil population of 863,000. The Region of Trier, as compared with the whole of Prussia, has always had a high death rate from tuberculosis (chart 3). This is attributed to its unfavorable climate, the prevalence of respiratory diseases, and the lack of a sufficiently organized effort to combat the disease. The Region of Trier is not an area with large cities and is relatively poor in comparison with other parts of Germany. Its population consists largely of farmers, who as a rule are not as interested in health measures as city people. It has also been observed that the housing conditions of even the farmers are not as good as one would expect, and the cleanliness upon which people in other parts of Germany pride themselves is not so apparent. Until recent times this region has been more or less isolated, so that considerable intermarriage has occurred, and the physical stamina of the poeple has suffered in consequence. It is also to be borne in mind that the principal industry is wine growing, so perhaps the inhabitants are accustomed to consuming more alcohol. All of these conditions combined are sufficient to explain the relative high rate of tuberculosis in peace times. The present health officer (Kreisarzt) in the City of Trier, while apparently very capable, is only a half-pay government physician devoting part of his time to private practice. It is the intention soon to employ an expert health officer who will apply himself only to health problems. During the war there has been a marked increase in tuberculosis, proportionately greater in the cities than in the smaller towns and country. The increase is shown by mortality statistics and also reports on living cases. The latter is shown by the records of the government sickness insurance offices. Two hundred and fifty members received insurance benefits on account of pulmonary tuberculosis in 1914, and 480 in 1918 (charts 5 and 6). At the tuberculosis dispensary in the City of Trier in 1916, 189 cases of tuberculosis were under supervision, and in 1918 the number advanced to 350. In 1913 the death rate per 100,000 inhabitants in the Region of Trier was 1491, and, by the end of 1918, this rate had risen to 267.5.

In the Region of Coblenz the rate increased from 1222 in 1913 to 1496 in 1918.

In considering the various districts (*Kreises*) in the area occupied by the American Army, the deaths from tuberculosis since 1912 have been distributed as follows:

	POPULATION	1913		1914		1915	
		Number of deaths	Number per 100,000	Number of deaths	Number per 100,000	Number of deaths	Number per 100,000
Trier region:							
Trier Stadt	53,899	110	204.1	92	161.4	94	167.8
Trier Land	91,595	41	44.8	118	128.8	131	143.0
Berncastle	45,074	74	164.6	61	135.3	74	164.6
Bitburg	45,977	49	106.6	23	50.0	25	54.4
Daun	31,122	19	61.0	24	77.1	17	54.6
Prüm	37,238	37	99.4	25	67.1	26	69.8
Saarburg	33,731	52	154.2	51	151.2	57	169.0
Wittlich	41,530	70	168.6	69	166.1	88	211.9
Coblenz Region:							
Coblenz Stadt	59,526	60	100.8	63	105.8	66	110.9
Coblenz Land	64,035	50	78.1	65	101.5	48	75.0
Cochem	41,433	60	144.8	71	171.1	39	94.1
Neuwied	93,500	69	73.8	59	63.1	69	73.8
Mayen	80,088	98	122.4	32	40.0	108	134.0
Adenau	25,742	16	62.2	17	66.0	34	132.1

	POPULATION	1916		1917		1918		1919
		Number of deaths	Number per 100,000	Number of deaths	Number per 100,000	Number of deaths	Number per 100,000	(Four months)
Trier Region:								
Trier Stadt	53,899	127	230.9	173	320.4	193	364.1	87
Trier Land	91,595	87	95.0	165	180.1	152	165.9	63
Berncastle	45,074	72	159.7	82	181.9	70	155.3	61
Bitburg	45,977	27	58.7	31	67.4	24	52.2	8
Daun	31,122	28	90.0	34	109.2	26	83.5	15
Prüm	37,238	23	61.8	46	123.5	71	190.7	20
Saarburg	33,731	57	169.0	76	225.3	71	210.4	24
Wittlich	41,530	72	173.4	101	243.2	96	231.1	44
Coblenz Region:								
Coblenz Stadt	59,526	65	109.2	89	149.5	114	191.5	64
Coblenz Land	64,035	45	70.3	73	114.0	61	95.2	52
Cochem	41,433	64	154.5	100	241.4	87	209.9	26
Neuwied	93,500	69	73.8	83	88.8	101	108.2	34
Mayen	80,088	92	114.9	100	124.9	120	149.8	52
Adenau	25,742	24	93.2	23	89.5	19	73.8	5

From the above table it will be seen that most deaths from tuberculosis have occurred in the districts with the larger cities. The significance of this will be discussed later. Outside of these cities very little anti-tuberculosis work is done, although in some of the larger towns tuberculosis dispensaries are in operation on a small scale. The dispensaries in Coblenz and Trier are well managed and doing excellent work. A number of hospitals in these cities have isolated wards or annexes for the treatment of tuberculosis. In Trier, as well as in Coblenz, factory nurses are on duty at all the large factories and special precautions are taken with reference to tuberculosis among the employees. The social welfare work of this area is well organized. At its head is the Region President (*Regierungspräsident*). Most of the administrative work is done by women workers (*Fürsorgerinne*). The chief *Fürsorgerinne* in the office of the Region President has under her one or more workers in each district. In all the districts, dispensaries have been opened on the same plan as the one at Trier. It also maintains homes for working girls and extends its aid to every question which concerns the health of the people. While this organization coöperates with the government and correlates all health activities, it functions independently and is financed by the invalid insurance offices, by the individual districts and by private subscriptions. It has been in existence only since 1917 and its success and magnitude will depend largely on the financial support which it receives. In addition, there are a number of country and convalescent homes in various parts of the mountains and forest for the treatment of scrofulous and anaemic children. The forest school near Trier has already been mentioned. Two tuberculosis sanatoria, one at Grünewald near Wittlich, and one at Sonnenburg near Saarbrücken, are maintained by the sickness insurance offices for the treatment of their members, but also receive other patients. Only adult males are admitted. The one at Grünwald was visited. It is located in a forest on the side of a mountain and affords a wonderful outlook for the patients. The cost of maintenance is 5.50 marks per day per patient. Only curable cases are admitted and receive three months' treatment. If not able to work then they are taken care of by the invalid insurance offices. The great difficulty encountered is in getting enough food to satisfy the sick. Those from the country, especially, complain that they can get much more to eat at home, and for this reason it is hard to keep them satisfied and under treatment. The meals consist of as follows:

First breakfast: 7 a.m.: milk, two slices war bread and butter
Second breakfast: 10 a.m.: bouillon or soup, one slice war bread
Dinner: 12 noon: soup, meat ($1\frac{1}{2}$ pounds per week), vegetables (green vegetables and potatoes)
Vesper: 4 p.m.: coffee substitute with milk, two slices war bread
Supper: 7 p.m.: meat and vegetables or soup, one slice war bread

During the war the various measures in the prevention of tuberculosis had to be neglected to a certain extent due to the shortage of doctors and nurses and to the fact that interest centered more in the care of wounded and other problems more directly pertaining to the military.

VARIOUS FACTORS ENTERING INTO THE TUBERCULOSIS INCREASE DURING THE WAR

Without quoting any further figures it is apparent that there has been a widespread and marked increase in tuberculosis throughout Germany during the war. The bearing this has on the food situation and its etiological significance remain to be explained.

The majority of civilized persons are infected with tuberculosis. Infection usually occurs in childhood and most people harbor latent foci of the disease in their bodies. Whether or not they develop clinical tuberculosis is largely a question of immunity or resistance. Manifest tuberculosis often appears during a period of overwork, anxiety and grief, poverty, dissipation, following other diseases, following childbirth, etc. In our army before the war, a large percentage of cases developed during tropical service. If for instance a soldier became sick with tuberculosis in the Philippine Islands and was fortunate enough to have his disease discovered in an early stage, he often arrived at the Army Tuberculosis Hospital, Fort Bayard, N. Mex., an arrested case. The explanation of this demonstrates the cause and principle of treatment of tuberculosis. The depressing influence of unfavorable climate weakens the protective forces of the body, thereby permitting latent infections to assume disease proportions. As soon as this influence is removed and resistance returns to normal, healing occurs. In the treatment of tuberculosis, every effort is made to promote the resistance or improve the health of the patient. The importance of immunity or resistance in the case of tuberculosis is demonstrated in other ways. It is a well-known fact that the mate of a tuberculosis person is no more likely to have tuberculosis than any other person; that doctors, nurses

and attendants of sanatoria who come in constant contact with the disease, do not necessarily develop it; that the native population in health resorts for consumptives are no more prone to the disease. In this connection the tuberculosis mortality statistics of the inhabitants of Lippspringe are of interest (11). Lippspringe has been a health resort, frequented by large numbers of consumptives, since 1833. The patients rented rooms and boarded with the inhabitants, so that it is said that every second house sheltered the sick. Thus there was a crowding together of numerous cases of pulmonary tuberculosis in a relatively small place and in a small community with enormous production and dissemination of tubercle bacilli for seventy-six years and the absence of all protective measures until about 1900, or sixty-seven years. The tuberculosis mortality among the native population, although in close contact and greatly exposed to infection, diminished about one-third.

Tuberculosis more than any other disease, therefore, must be controlled from the standpoint of resistance; and too much prominence should not be given to the element of infection. The relative part infection and resistance have played in the tuberculosis increase is very difficult to definitely prove. Attention need only be called to the reports on tuberculin tests to show that in all probability plenty of opportunities for infection existed prior to the war, but, as far as children are concerned, owing to the undernourishment, scarcity of clothing, lack of care, etc., occurring during the war, infection resulted more often in clinical tuberculosis. If the number of tuberculosis infections have increased, it will require later years to verify this. The age curve of tuberculosis mortality runs about parallel with that before the war (chart 9). It is true that more cases of tuberculous meningitis, caseous pneumonia and miliary tuberculosis are seen, but except when occurring in children they are usually associated with old lesions. The serial autopsy findings with reference to latent tuberculosis, among the most quoted being Naegeli's, who found signs of this disease in 97 per cent of a series of 500 bodies examined at Zürich, demonstrate the great frequency of latent lesions among the German people (12).

All authorities will agree that when the incidence of tuberculosis in a civilized country is increasing we must by all means search for causes which are lowering the health and resistance of the population as well as for sources of infection.

It has been suggested that the tuberculosis increase in Germany was largely due to the dying off of those already clinical tuberculous. Although death has reaped a rich harvest among the consumptives in consequence of the war, there is plenty of evidence to show that many new cases have developed. This we know from the records of dispensaries, clinics, insurance offices and the common observation of all doctors. The new cases in adults comprise mostly those due to a flaring up of old foci never before manifest.

It is very difficult to determine the relative increase with reference to sex on account of the constant shifting of the male population during the war. The fact that women have been employed largely in munition factories and have had to perform unusual and extra work would lead us to expect a greater increase of tuberculosis among them. Weber reports that in Berlin the working women were hard hit by tuberculosis (5). According to his report the average annual mortality in Berlin from pulmonary tuberculosis in the years 1913-1916 was 3375, and in 1917, 5045, an increase of 49.5 per cent. A comparison of the first nine months of 1918 with corresponding periods of 1917 and 1913–1916 showed an increase of 54.58 per cent for 1917 and 48.68 per cent for 1918. The increase among males was 43.47 per cent. in 1917 and 30.63 per cent in 1918; and among females, 68.72 per cent in 1917 and 71.67 per cent in 1918.

The increase in communicable diseases, particularly the epidemic of grippe, may have played some rôle in the greater tuberculosis rate. This, however, is not believed to have been a very important factor, as the influenza epidemic was confined mostly to 1918, and the tuberculosis increase was already very marked in 1916 and 1917. From data obtained in the A. E. F., there is no convincing proof that measles, bronchitis, pneumonia and influenza played a very large part in the etiology of tuberculosis.

The living conditions of the German poor and working class are said to have been comparatively good before the war; but at the present time, judging from conditions in Trier, this cannot be said to be the case. A thousand of the poorer families were visited by German-speaking American nurses and first-hand information obtained with reference to their environment, food, clothing, income, etc. The result of this investigation showed that in the poorer tenements large families are crowded into small two and three room apartments, badly lighted, poorly ventilated, dirty and infested with vermin. In 757 families

some member was sick; in 379 families some member had tuberculosis. There were 343 cases of pulmonary tuberculosis and 249 cases of scrofula. These figures probably overestimate the relative amount of tuberculosis among the poor people of Trier, as visits were made in company with the German dispensary nurses, who naturally would include all families under supervision of the clinic.

The effects of the war taking away sons, fathers and brothers put an extra amount of work on the women, causing a laxity in the care of the infants and neglect in the cleanliness of the home. Under the necessities of a severe and prolonged war, women and children were required to do the work of men, working long hours under high pressure and at unusual tasks. Coupled with all this, the worry, anxiety and sorrow made a favorable soil for the growth and development of the tubercle bacillus. How large a part environment played in the war tuberculosis cannot be said. That it was not as important an etiological factor as food will be shown later. We are told that the tuberculosis death rate in France, although high, increased very little during the war (2). The industrial and economic conditions were about the same in France as in Germany, but the suffering for want of food was much less in France.

In examining 2500 school children, mostly from the poorer districts, it was found that their clothing consisted of odds and ends made over from their parents' clothing, that very few of them wore any underwear and that woolen garments were rare. Living in poorly heated houses and not being warmly clothed have therefore predisposed them to respiratory infections, which would indirectly have some influence on the incidence of tuberculosis.

Among other etiological factors usually mentioned with reference to tuberculosis is alcohol. This, however, can be ruled out as a contributing cause peculiar to the war, because owing to a shortage of grain and increase in prices, less alcohol was consumed, especially by the poorer classes.

Since the early part of 1915 all the people of Germany have been on a war ration. The calory value of the food eaten daily before the war was 3000, of which 12 per cent was protein, 20 per cent fat and 68 per cent carbohydrates. The war ration contains only 1400 calories, of which 8 per cent is protein, 9 per cent fat and 83 per cent carbohydrates. Before the blockade was modified each person was receiving 30 grams of fat, 100 grams of meat, 20 grams of sugar, 7 pounds of potatoes and 4 pounds of war bread per week. We would naturally expect such a reduced

diet to have a deleterious effect on the health of the people, especially children and those doing manual labor. In the examination of the school children of Trier, a great majority showed anaemia, undernourishment and undevelopment. This was particularly true in the public schools. In examining children in the country schools, especially in the richer farming districts, very little malnutrition was noticeable. The farmers have been able to hold on to extra supplies and have not been as hard hit by the war ration as the city people. It is believed that children more than adults have suffered from the great reduction in fats. The marked increase in scrofula probably has for its greatest etiological factor the lowering of the nutritional standard. The health officer (*Kreisarzt*) of Trier, in his annual reports, points to the food shortage as a large factor in the increase of tuberculosis. He has always noted that in lean years tuberculosis increased and that during the war, in periods when the food shortage was greatest, more cases were seen by him in his clinic. In the early fall of 1916, when the food consisted largely of beets, tuberculosis began to increase. In May and June, 1917, there was a marked rise, due, he believes, to the shortage of potatoes. It is interesting to note that the tuberculosis death rate and number of living cases has increased more in the cities. This would point to the war ration as playing a large factor, for the country people have had more and better food. Thus in the City of Trier, the tuberculosis death rate per 100,000 has increased from 161.4 in 1914 to 364.1 in 1918, as compared with the country district, which has increased from 134 in 1914 to 170 in 1918. In the cities of Prussia, the tuberculosis deaths increased from 31,653 in 1913 to 50,495 in 1917, but in the country districts the increase was less marked, namely, from 25,208 in 1913 to 35,722 in 1917 (chart 7). Cases of pulmonary tuberculosis, applying for sickness insurance, increased in the City of Trier from 44 in 1914 to 208 in 1918; in the City of Saarbrücken from 44 to 110; while in the country circles adjacent to these cities from 19 in 1914 to 46 in 1918 (charts 5, 6, 7).

In opposition to such proof it may be objected that the country people live under better hygienic surroundings. This, however, is not the case. In Germany the farming population does not live in isolated homes such as we see in America, but in small villages, and it is a well-known fact that the housing conditions are not as good and sanitation not as perfect as in the cities. In examining school children, two different country schools were selected, one in a poor section where the farmers had been

to a large extent on the war ration, and another in a richer section where the food shortage has not been felt. In the latter the children were almost up to the standard, but in the former they showed marked undernourishment and underdevelopment.

SUMMARY

The following points seem to stand out most prominently with reference to the tuberculosis situation in Germany:

1. The German methods of combating tuberculosis are about the same as those employed by the best state health organizations of our own country.

2. Before the war Germany, by means of a well-organized and efficient health organization, was carrying on a successful campaign against tuberculosis. Due to this and also to the fact that as a great industrial and commercial power she had become a tuberculosis-immune nation, her comparatively low death rate from tuberculosis was steadily decreasing. The latter especially necessitates studying the tuberculosis situation during the war more from the standpoint of lowered resistance. In other words, we have a nation highly infected with tuberculosis, with chronic and curable forms of the disease and with few deaths. A large percentage of the population were harboring latent foci or holding in check quiescent lesions. Under the favorabe conditions of peace, they could do this successfully, but under the depressing influence of the war, clinical and fatal tuberculosis resulted.

3. In the area occupied by the American Army, tuberculosis is slightly more prevalent and the death rate relatively higher than that of Prussia. In this area an active campaign is being carried on against the disease, which at least in the cities is well organized.

4. Tuberculosis in all its forms and for all ages has markedly increased during the war.

5. Of all the etiological factors entering into this increase, the shortage of food is most important.

Thus we have undernourishment, overwork, the stress and strain of a long war and unfavorable environment preparing a fertile soil for the tubercle bacillus to flourish in all its glory. The anxieties of war have ceased, although the wounds of sorrow have not healed. Environment largely the result of poverty cannot be greatly improved until Germany is once more prosperous. The food situation, which is no doubt the

greatest factor in the cause of the tuberculosis increase, can, however, be remedied. Tuberculosis patients are dying because they cannot obtain the proper nourishment so essential to the treatment of their disease. Those infected are becoming clinically tuberculous. Unquestionably the children of the poorer classes in the cities and the sick are suffering as a result of the shortage of food and should be the first to receive relief. The increase in tuberculosis is relative to the shortage of food, and improvement of the food supply is necessary for its reduction.

REFERENCES

(1) Weekly Bulletin No. 41, Office of the Chief Surgeon, S.O.S., A.E.F.
(2) Miller, J. A.: How America is helping France with the tuberculosis problem. Amer. Rev. Tuberc., 1918, ii.
(3) Das Gesundheitswesen des Preussischen Staaten, 1910–1909–1913.
(4) Morris, M.: The fact and the future of the crusade against tuberculosis. Brit. M. J., Nov. 16, 1918.
(5) Berl. klin. Wchnschr., 1919, lvi, 3.
(6) Statistisches Jahrbuch der Stadt Köln, 1919. Statistisches Jahrbuch für den Preussischen Staaten, 1910–1914.
(7) Annual Report Tuberculosis Dispensary, Cologne, 1918.
(8) Drügg, W.: Unternährung und chirurgische Tuberkulose. Deutsch. med. Wchnschr., 1919, 14.
(9) Annual Report Minister of the Interior, Berlin, 1918.
(10) Noeggerath, C. T.: Zeitschr. f. Säuglings u. Kleinkinder-Schutz, October, 1917.
(11) Werner: Die Sterblichkeit der Bevolkerung Lippspringes an Tuberkulose. Beitr. z. Klin. d. Tuberk., xxiii.
(12) Naegeli: Uber die Häufigkeit der Tuberkulose. Verhandl. d. Kongress f. Inn. Med., Wiesbaden, April, 1907.
(13) Report on the incidence of tuberculosis in the German Army, by the U. S. Military Mission, Berlin.

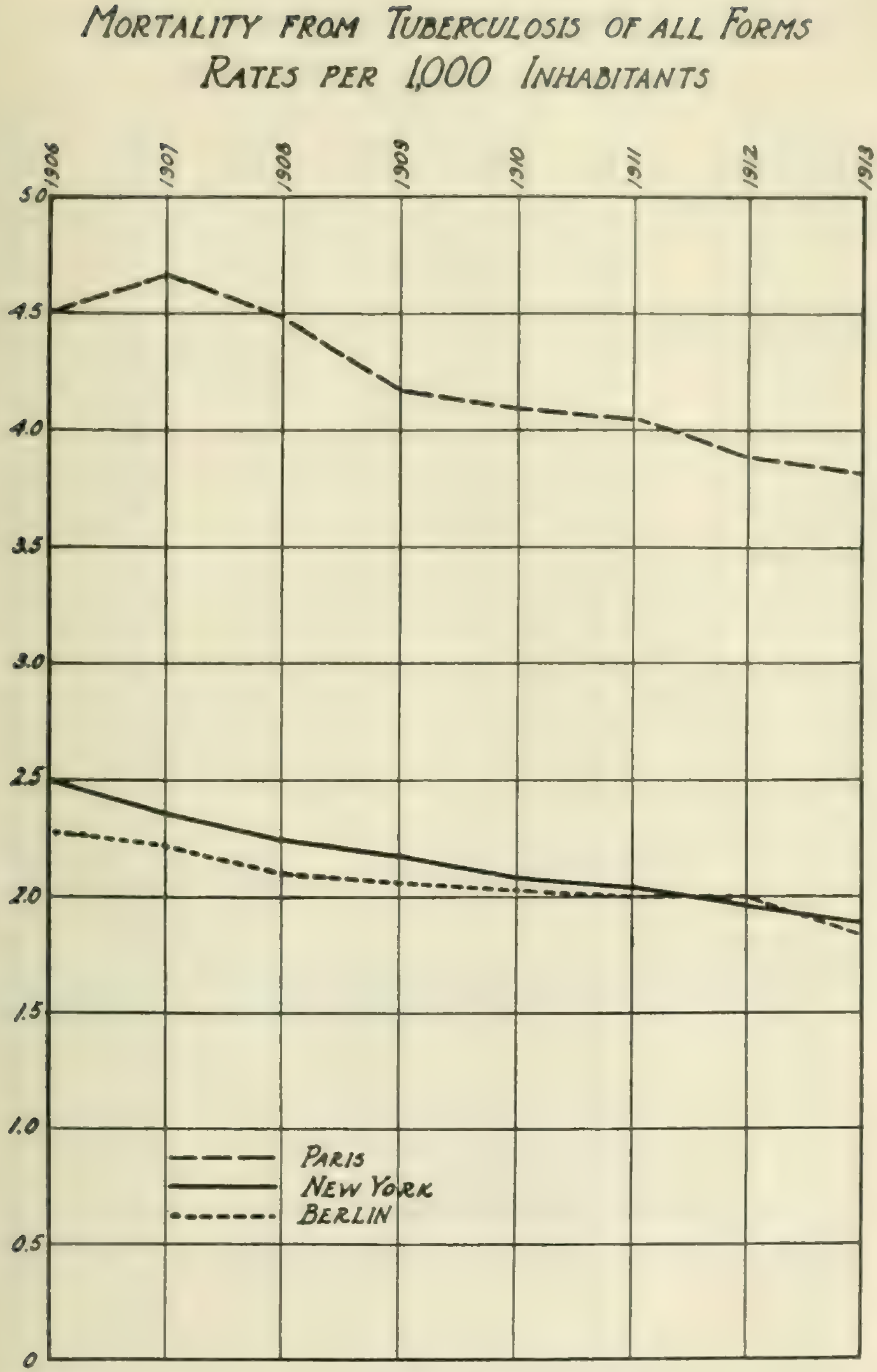
MORTALITY FROM TUBERCULOSIS OF ALL FORMS
RATES PER 1,000 INHABITANTS
1906
1907
1908
1909
1910
1911
1912
1913
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
PARIS
NEW YORK
BERLIN

CHART 1

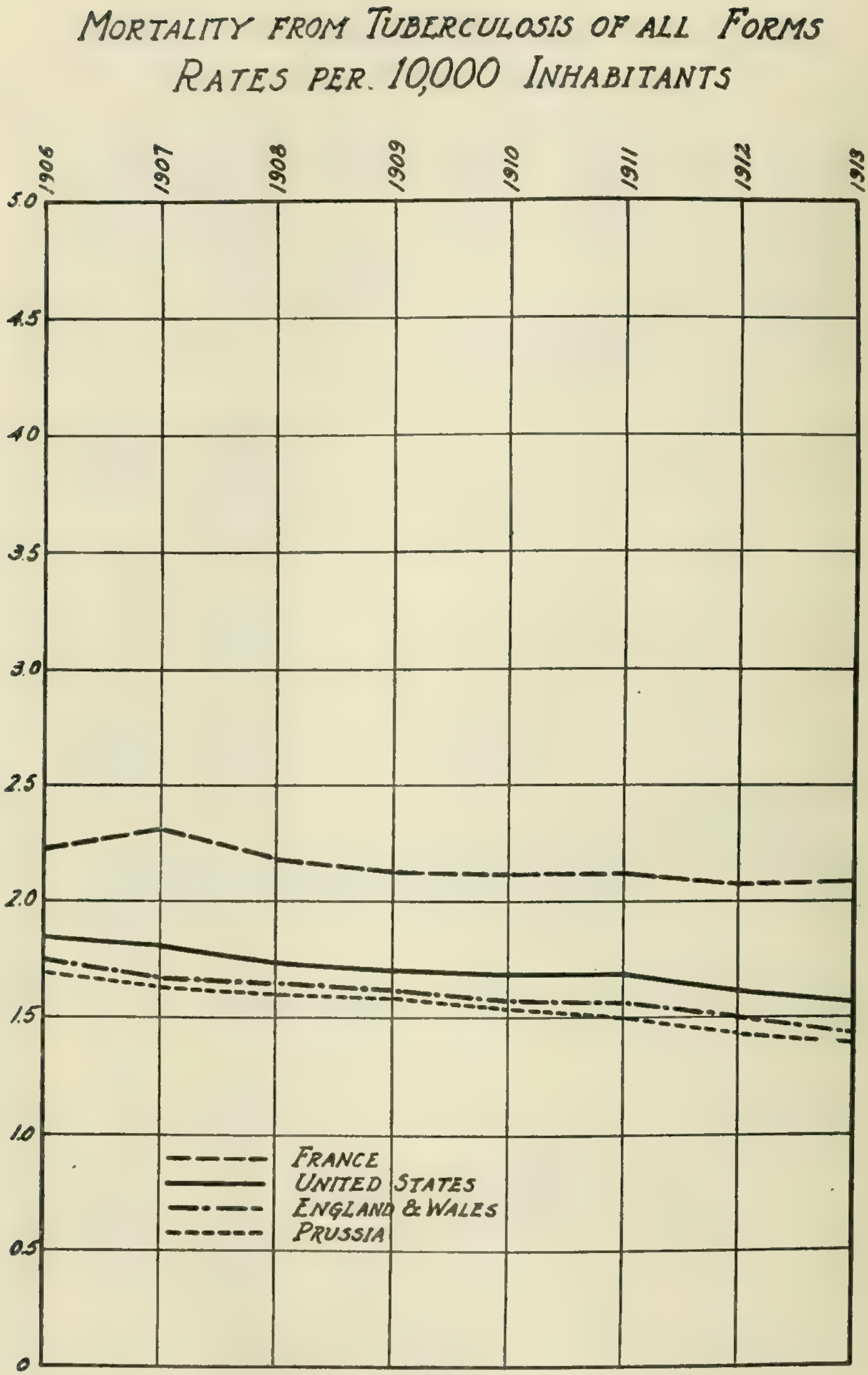
MORTALITY FROM TUBERCULOSIS OF ALL FORMS
RATES PER 10,000 INHABITANTS
1906
1907
1908
1909
1910
1911
1912
1913
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
FRANCE
UNITED STATES
ENGLAND & WALES
PRUSSIA

CHART 2

TUBERCULOSIS MORTALITY RATES FOR PRUSSIA & TRIER DISTRICT

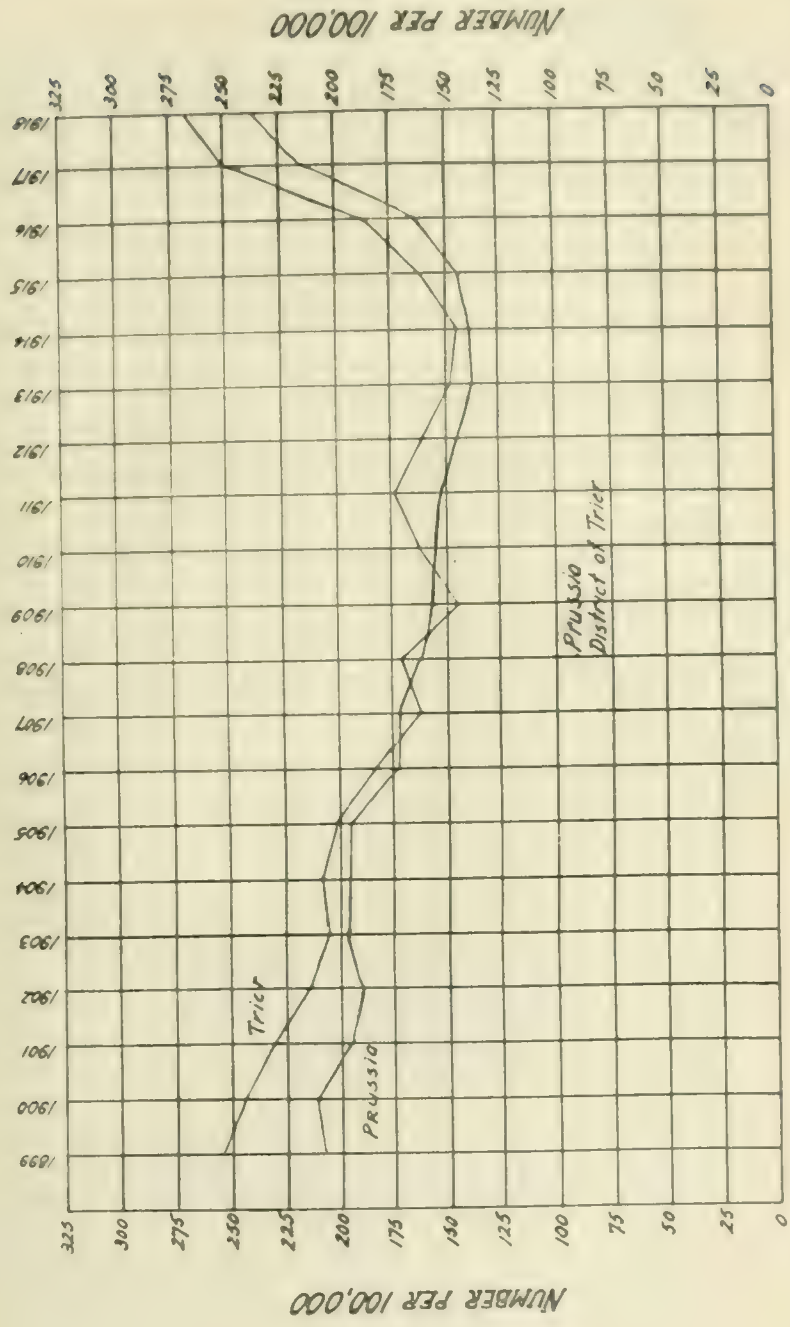

CHART 3

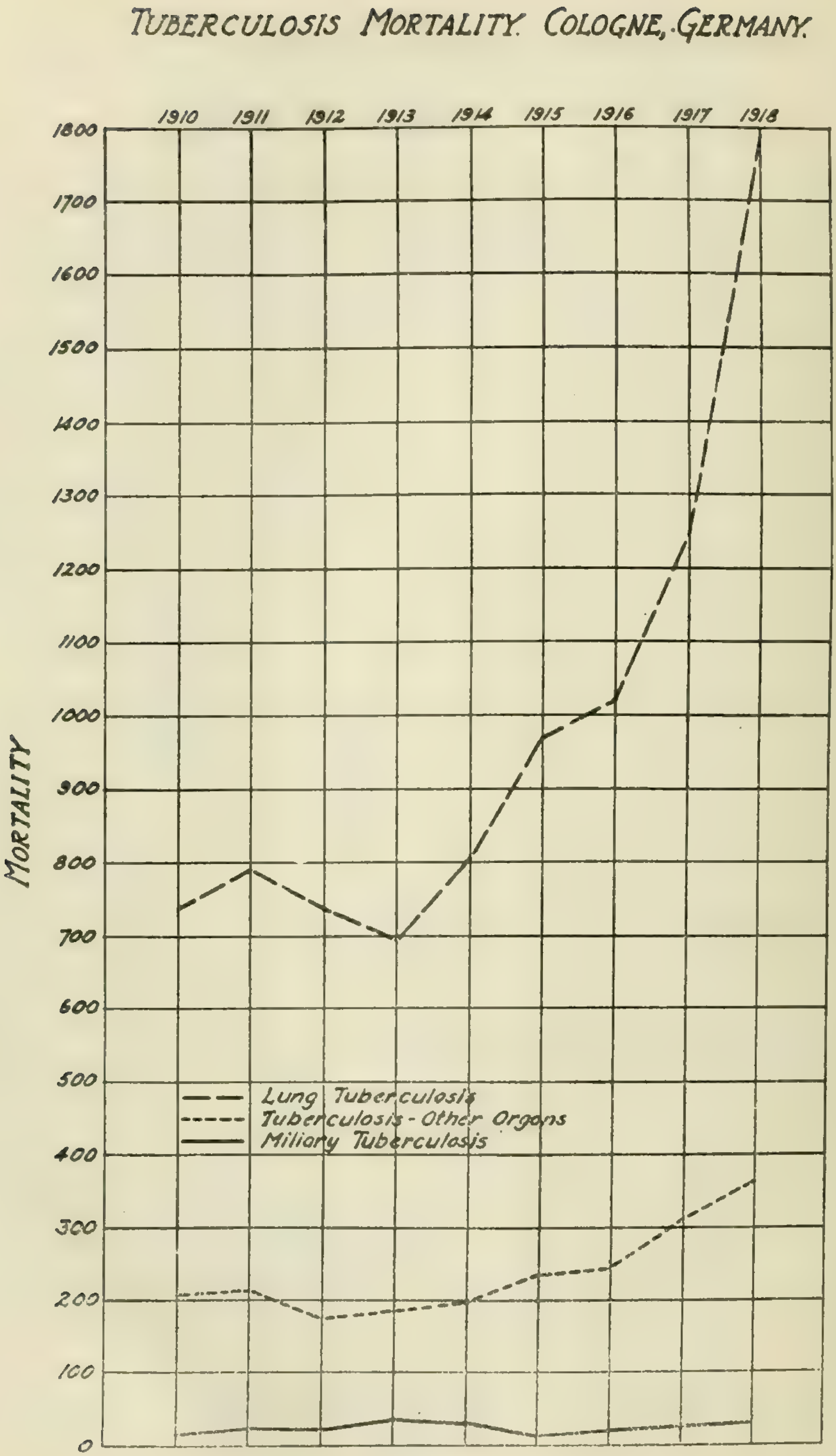
TUBERCULOSIS MORTALITY. COLOGNE, GERMANY.
1910 1911 1912 1913 1914 1915 1916 1917 1918
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
MORTALITY
Lung Tuberculosis
Tuberculosis - Other Organs
Miliary Tuberculosis

CHART 4

PULMONARY TUBERCULOSIS

TUBERCULOSIS STATISTICS ON LIVING CASES REPORTED BY THE GOVERNMENT INSURANCE OFFICES IN THE CITIES OF TRIER AND SAARBRUCKEN AND THE TOWNS OF NEUNKIRCHEN ATTWEILER AND SULZBACH

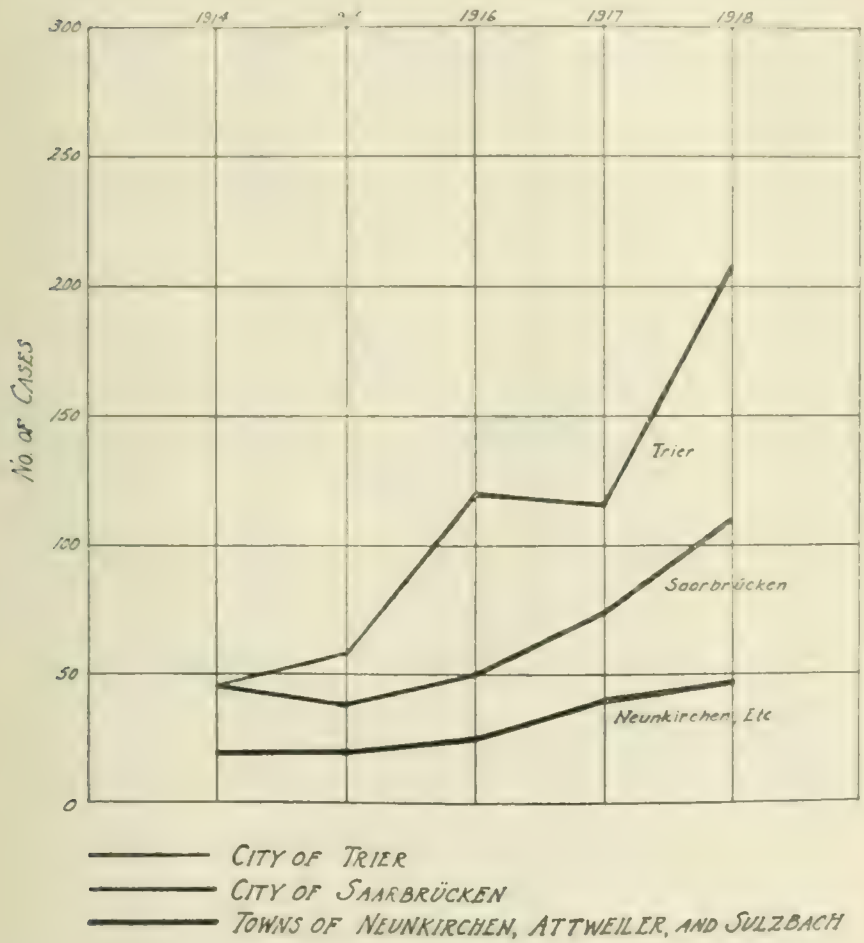

CHART 5

LUNG APEX CATARRH (INCIPIENT TUBERCULOSIS)

TUBERCULOSIS STATISTICS ON LIVING CASES REPORTED BY THE GOVERNMENT INSURANCE OFFICES IN THE CITIES OF TRIER AND SAARBRUCKEN AND THE TOWNS OF NEUNKIRCHEN, ATTWEILER AND SULZBACH

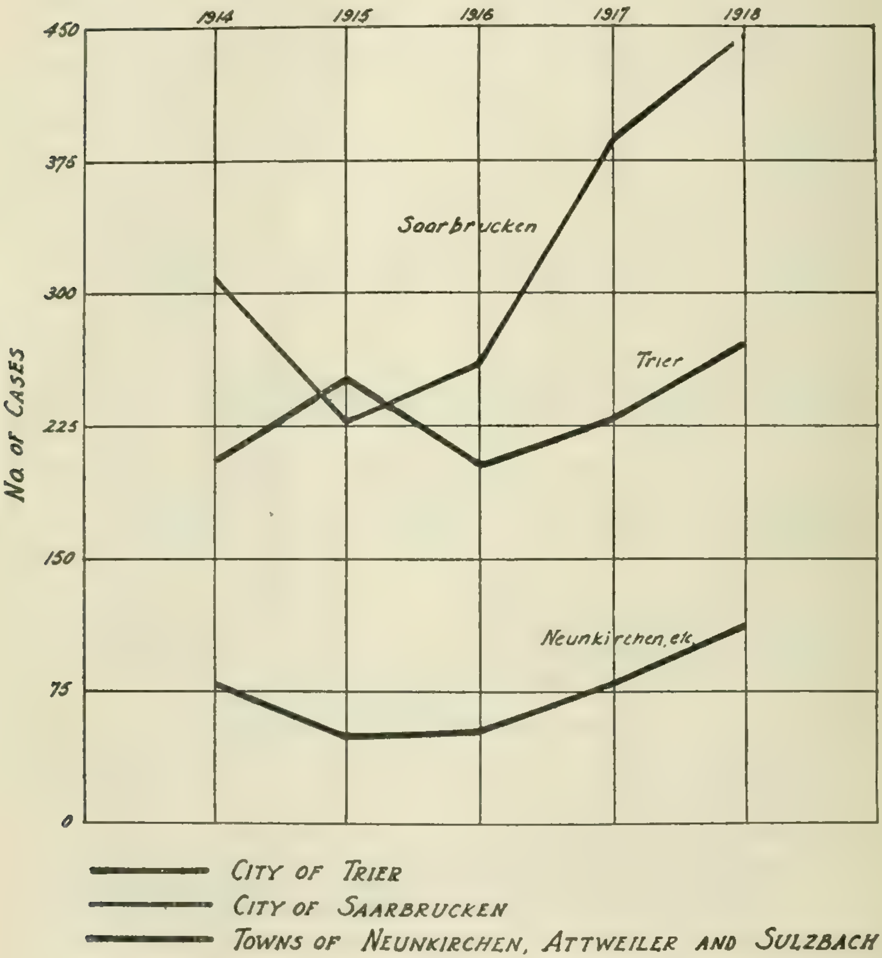

CHART 6

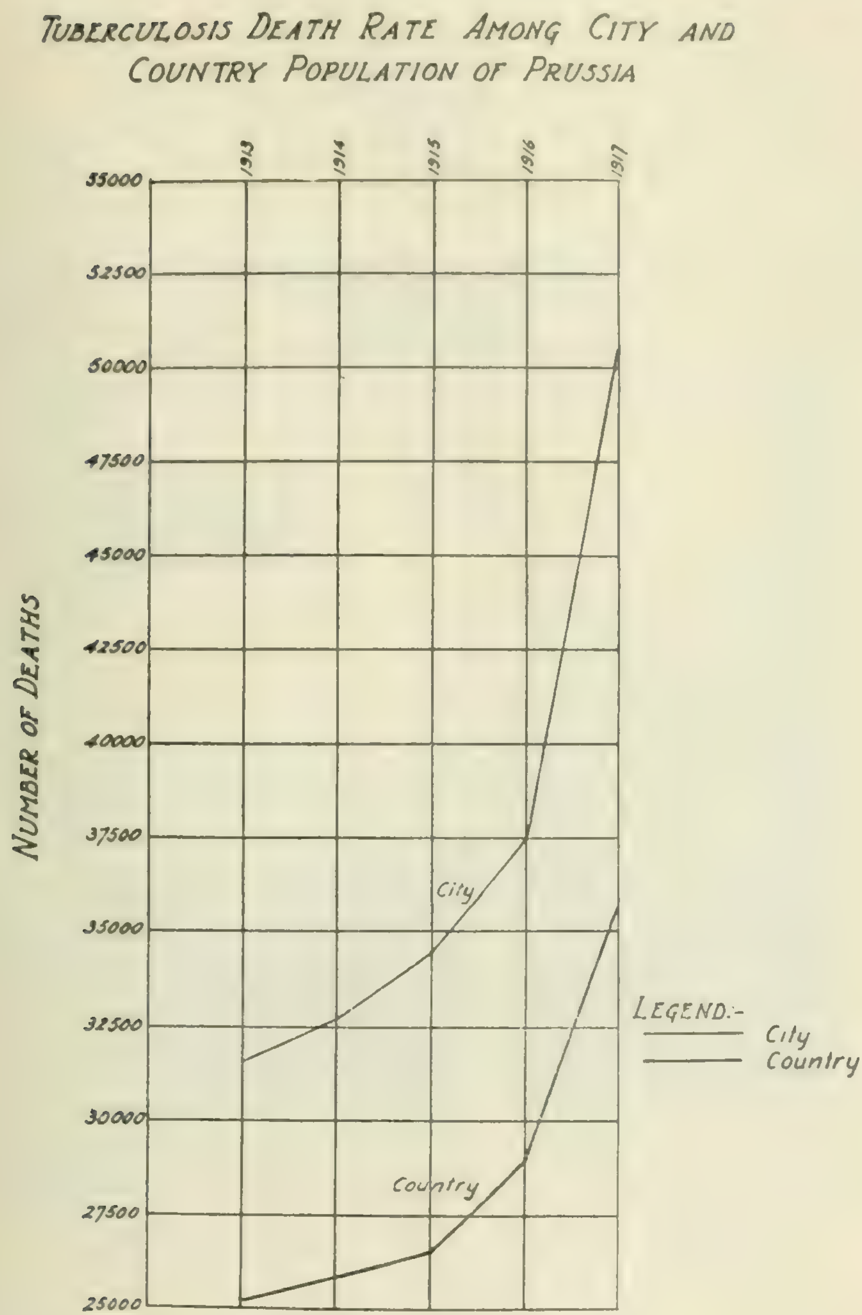
TUBERCULOSIS DEATH RATE AMONG CITY AND COUNTRY POPULATION OF PRUSSIA
1913
1914
1915
1916
1917
55000
52500
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
NUMBER OF DEATHS
City
Country
LEGEND:-
City
Country

CHART 7

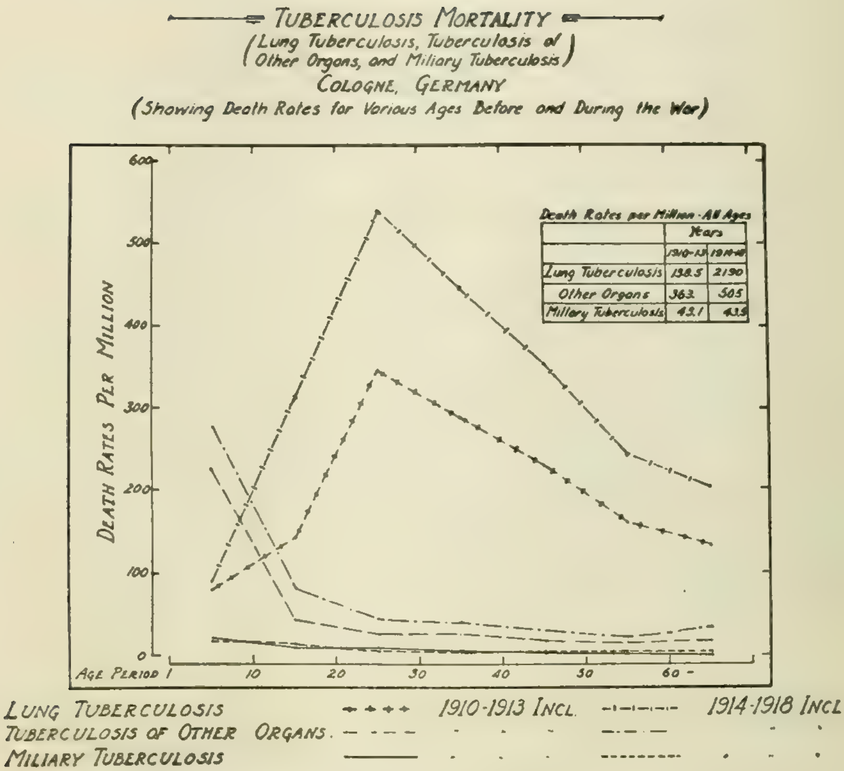
TUBERCULOSIS MORTALITY
(Lung Tuberculosis, Tuberculosis of Other Organs, and Miliary Tuberculosis)
COLOGNE, GERMANY
(Showing Death Rates for Various Ages Before and During the War)
Death Rates per Million - All Ages
Years
1910-13
Lung Tuberculosis 138.5 2190
Other Organs 363 505
Miliary Tuberculosis 43.1
DEATH RATES PER MILLION
600
500
400
300
200
100
0
AGE PERIOD 1
10
20
30
40
50
60 -
LUNG TUBERCULOSIS
TUBERCULOSIS OF OTHER ORGANS
MILIARY TUBERCULOSIS
1910-1913 INCL.
1914-1918 INCL

CHART 8

ALL FORMS OF TUBERCULOSIS
1909 - 1918
REGIERUNGSBEZIRKE OF
COBLENZ - POPULATION 753,301 IN 1910 AND TRIER - POPULATION 1,001,770 IN 1917
DEATHS AND DEATH RATES PER 100,000.

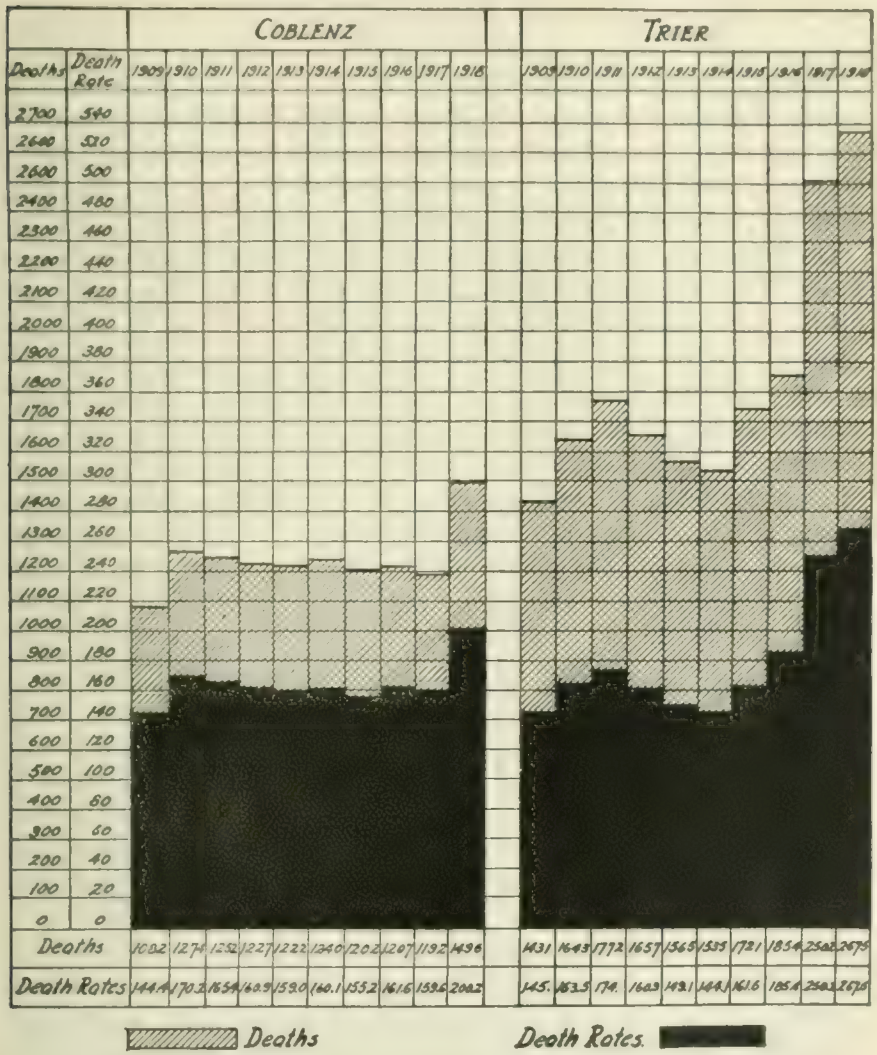

CHART 9

THE ELIMINATION OF TUBERCULOSIS FROM THE ARMY

RALPH C. MATSON[1]

Portland, Oregon

The end of the war leads necessarily to a contemplation of the application in civil life of some of the lessons learned during the war, and in this connection the utilization of the principles formulated by Colonel George E. Bushnell, of the Surgeon General's Office, for the elimination of tuberculosis from the army, is well worth a serious consideration.

On account of the report authorized by Professor Landouzy, one of France's most prominent physicians, that 86,000 French soldiers were discharged the first year of the war because of tuberculosis, it was justly assumed that the situation was indeed serious and that warfare exerted a very disastrous influence upon the development and spread of pulmonary tuberculosis. Accordingly, laymen and physicians expressed themselves that the slightest indication of the presence of tuberculosis or its preëxistence was sufficient basis for rejection of registrants or discharge of our soldiers from military service.

Apprehension was felt at the time we entered the war by not only the National Tuberculosis Association, but also by the Surgeon General's Office, that we should find our combatant forces menaced by tuberculosis. Accordingly, the Surgeon General decided that the entire army, if possible, should be examined for tuberculosis by specially trained physicians, as it was even a more vital issue with us than with the French and British, on account of our long lines of communication, shortage of transport, and difficulty of hospitalization. To have the added handicap of large numbers of tuberculosis cases would not only materially reduce the fighting effectiveness of our army, but would fill beds that should take care of the inevitable percentage of sick and wounded.

The occurrence of any surplus of tuberculosis among the French and British troops was excused on the grounds that these were mobilized quickly and that existing extenuating circumstances made examination impossible, but laymen assumed that we had no excuse. Granting we were forewarned, it must be remembered that we also mobilized quickly,

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especially the second draft. At that time the German armies were making headway toward Paris, and the machinery of mobilization and training in this country was working to its utmost to send soldiers to the aid of our allies at the earliest possible moment. Registrants were pouring into camps in great numbers and the time allowed for examination was too short.

At Camp Lewis, for instance, increments approximating 15,000 men arrived about the first of each month. These men were examined at the rate of 1500 a day and the examination completed within twenty-four hours, and the men assigned to organizations, or rejected and sent home to make room for others. Decision to accept or reject had to be made at once. There were no facilities for extending observation. Furthermore, there was a scarcity of competent trained examiners, and the necessity for examinations being made rapidly, in surroundings decidedly unfavorable for auscultation and percussion, made it obvious that all that could reasonably be expected was the detection and rejection of manifest cases of pulmonary tuberculosis. Moreover, the diagnosis of tuberculosis at military camps was exceedingly difficult because of the enormous numbers of acute respiratory infections due to the hemolytic streptococcus which in many instances invaded the peribronchial tissues, producing an interstitial bronchopneumonia. Added to this, there were still other difficulties encountered in military examinations which did not exist in civil practice. There were first, the statements of men as to symptoms which could not be accepted at anything like their appraised value in civil practice, but required the support of objective evidence, because, where one man through patriotic motives misrepresented the truth regarding his physical condition to get in, another of the slacker type would deliberately lie to get out of the service, while still others seeking enlistment concealed symptoms, hoping to obtain treatment or compensation. Many claimed they were tuberculous, and supported their claims by letters from physicians. Hundreds of these letters were brought to Camp Lewis by registrants from the Southwestern States.

Moreover, there was not only the responsibility that obtains in civil practice of deciding what was best for the individual, but a national crisis existed, and we had also a responsibility to the country. It was important to secure soldiers, and while we had enormous manpower, we had no right to waste it by permitting men with questionable signs of tuberculosis, in the way of slight or questionable deviations from the normal, to escape service. It was therefore necessary that conclusions

as to the existence or nonexistence of tuberculosis be based on carefully weighed evidence.

In spite of all these difficulties, very definite plans formulated by Colonel Bushnell were under way within two months after the declaration of war. Colonel Bushnell outlined the principles, and standardized the methods and indications which were to govern in deciding as to the existence of pulmonary tuberculosis in a form incapacitating for military service. These principles were outlined in a somewhat radical way perhaps, and issued in the form of a War Department circular (circular 20), which naturally aroused some opposition among the tuberculosis specialists of the country. However, this was rather to be expected; for, naturally, concrete statements regarding what was and what was not tuberculosis, of a character rendering the individual unfit for military service, was a new problem with which none, with the exception of Colonel Bushnell, had had practical experience; and controversy was inevitable, because it contemplated accepting for service those with arrested or healed lesions of minimum extent and in good physical condition, contrary to the generally accepted idea that an individual who had even a history of tuberculosis should not render military service.

Time permits only the briefest reference to some of the more important principles outlined by Colonel Bushnell. He maintained that the first tuberculous focus accessible to physical examination is not the initial focus of the disease—in other words, he revived the teachings of Laennec and held that physical examination does not reveal the existence of an incipient focus of active tuberculosis before the advent of râles, and that many of the generally accepted signs of recent or incipient disease, such as bronchovesicular breathing or roughened inspiration with prolonged expiration, combined with impairment of percussion resonance over the upper part of the upper lobe of a lung, in the absence of râles, is evidence of an old or obsolete lesion rather than incipient or recent one, as these signs are due to induration of lung tissue; and induration caused by acute inflammation is relatively rare in pulmonary tuberculosis of a type likely to be present in registrants reporting to a camp for examination, as the process is not generally met with in an ambulant adult in apparently good health, and, when it does occur, the individual is manifestly ill.

Colonel Bushnell also pointed out that most of the above types of lesions are old lesions, and possibly abortive types of tuberculosis described by Bard, and that manifest tuberculosis of the cortex of the lung, which clinicians are accustomed to call an early lesion, is a relatively late development.

This view is supported by Piery, who states (quoted by Bushnell), "The error of thirty years has been to attribute to an incipient lesion what really proceeds from an old attenuated or abortive tuberculosis, and from this error has sprung eminently disastrous results in the field of practical medicine." Laennec, the father of modern diagnosis, taught that discrete tubercles in the healthy lung tissue could not be recognized until the occurrence of râles. Grancher and his followers, however, taught that changes in breathing became apparent before the focus softened. The Laennec view, however, as Colonel Bushnell points out, is supported by the post mortem evidence that early miliary tubercles cannot be detected by physical signs, and that the size of the tuberculous focus found at autopsy is much greater than determined during life by physical diagnostic methods. Furthermore, autopsy shows that recent extensions from old lesions escape detection by clinical methods; therefore, it is not reasonable to expect that incipient *circumscribed foci* in the apex would be detected by auscultation and percussion before râles make their appearance, because if auscultation cannot detect foci of miliary tubercles or recent fresh extensions of chronic tuberculosis before râles develop, there is no reason why it should be expected to detect scattered or minute foci of apical tuberculosis.

Colonel Bushnell insisted upon proper interpretation of the significance of râles, which he divided into those of acute inflammatory processes, the crepitant and subcrepitant, and those of chronic inflammatory processes, which he termed "indeterminate" râles, because they have no fixed place of origin, no fixed size, and are not connected with any definite period of respiration. These latter are the râles associated with chronic inflammatory processes of manifest pulmonary tuberculosis. Colonel Bushnell maintained that the only trustworthy sign of activity was the presence of persistent moist râles.

There has been a constant effort on the part of clinicians to devise new methods of early diagnosis, assuming that the earlier the diagnosis the greater the percentage of cures, and because of the difficulty of diagnosis of early tuberculosis, innumerable ultrarefined methods of percussion have been brought out, largely through protégés of the Grancher school. However, the physiological range of normal disparities is so great that one should not and cannot expect auscultation or percussion to furnish positive evidence regarding questionable deviations from the physiological, bordering on pathological changes.

Undoubtedly, active tuberculosis is often diagnosed when no clinical tuberculosis exists; and old, spontaneously healed and arrested foci are mistaken for incipient lesions, subjecting patients to unnecessary treatment, which often can be ill afforded and, what is of more moment, the real disease being overlooked. This not only obtains in civil practice, but in military service also, as an enormous percentage of the cases, diagnosed as tuberculosis and sent to the army tuberculosis hospitals from base hospitals and camps, were found to be incorrectly diagnosed. The mistakes comprised overlooked focal infections, syphilis, hyperthyroidism, acute respiratory infections of the streptococcic type, pernicious anemia, carcinoma, sarcoma, lung abscess, bronchiectasis, foreign bodies in lungs, etc. Thus, hospitals and sanatoria have been filled needlessly, and statistics as to the curability of tuberculosis and methods of treatment vitiated; and in military service this is even more vital, because men qualified for service are excluded. According to Major Rist, of the French army, subsequent histories of the 86,000 discharged French soldiers, referred to above, showed that less than 20 per cent were ultimately determined to be tuberculous. The services of these soldiers were lost to France at a time she needed men badly. Furthermore, in this country during demobilization, the discharge of soldiers thought to be suffering from tuberculosis by careless examiners was delayed and they were held for unnecessary treatment, as War Department orders prohibited demobilization of tuberculous soldiers, and all had to be sent to army tuberculosis hospitals for treatment.

Aside from the economic cost to the country of these mistakes in civil practice, we must consider the cost of such mistakes to the United States Government, when it is estimated that the cost is about $5000 for every soldier returned as tuberculous from overseas, and $1000 for every soldier who broke down in this country.

Mistakes in diagnosis are commonly based upon misinterpretation of X-ray findings. The X-ray cannot detect fresh tubercles in the lungs when discrete, and it should be appreciated that careful physical examination generally predicts the roentgenological findings, except in deep peribronchial types of tuberculosis. The roentgenological findings alone are of little value unless interpreted by one having a knowledge not only of roentgenology, but also of tuberculosis from a clinical and pathological standpoint. As compared with the physical examination, the roentgenological examination, even when done by an expert, occupies a place of secondary importance in the diagnosis of tuberculosis of clinical significance.

Of 570 second draft men at Camp Lewis rejected with clinically evident tuberculosis, the roentgenologists recognized 54 per cent as positive tuberculous. In an other group of 343 men whom the roentgenologist stated were unqualifiedly tuberculous and should be rejected on X-ray findings alone, irrespective of physical findings, only 315 were rejected after physical examination. The remaining 28 were considered either nontuberculous, or to have obsolete lesions, and were accepted for service. We have been able to follow these men through their military career, and none has developed tuberculosis. Among another group of 1500 whom the roentgenologist diagnosed as very suspicious of tuberculosis, physical examination revealed only 128 cases of tuberculosis, which were rejected. No case of tuberculosis developed among the remaining 1372 who were accepted for service.

Before presenting the results of the examination of 174,212 men in military service, and a study of 3000 clinical records at U. S. Army General Hospital No. 21, permit me to refer to the organization and plan of examination used.

The organization and plan of examination employed at Camp Lewis has already been described by the writer (1) (2). The plan was the outcome of observations by Major Ray W. Matson in the examination of the command for tuberculosis at Vancouver Barracks, Washington, August, 1917. During the course of these examinations it became apparent that, in the absence of specially trained tuberculosis examiners, some plan would have to be worked out which would bring masked forms of tuberculosis and those with minimum physical findings to the attention of the president of the board. Accordingly, an informal history was devised and adopted for the work at Camp Lewis and carried out under my direction (Form 1, Camp Lewis Board).

The Camp Lewis Tuberculosis Examination Board for the second draft was organized to examine 1500 men daily and comprised twenty preliminary examiners (ten inexperienced) and two experienced examiners, who acted as refer examiners (the president of the board and his assistant).

In selecting preliminary examiners, an effort was made to get officers who were especially interested in the subject, the idea being to give a considerable number of medical officers service on the board so that organizations going overseas would have at least one medical officer with some special knowledge of the diagnosis of tuberculosis. Therefore, fully half the personnel of the board was constantly changing on account of

temporary assignments for duty during the incoming draft increments. The other half constituted a permanent board and was made up of officers who, during their temporary assignment, exhibited special talent. Each permanent member took a temporarily assigned officer under his supervision.

The preliminary examiners were instructed to interrogate every man verbally regarding family history, past and present history along the lines indicated in Circular B of the Camp Lewis Board, and according to the informal history form (Form 1 of the Camp Lewis Board). The physical examination was then made as suggested in Circular A of the Camp Lewis Board and Circular 20, S.G.O., following the principles so masterfully outlined by Col. George E. Bushnell. If the preliminary examiner had reasons to suspect tuberculosis, either from the man's family history, past history, or the results of the physical examination, he was required to initiate the blank history Form 1, send the man in for fluoroscopic examination and to the refer examiner for opinion and disposition. In any event, this procedure was carried out in cases presenting any of the following circumstances:

A. History of prolonged contact with, or death in the family from, tuberculosis.

B. Inability to work because of ill health.

C. Well-defined history of previous pleurisy, pneumonia, frequent or protracted colds, typhoid fever or any other past illness of prolonged cough accompanied by expectoration, hemorrhage from the lungs or expectoration of bloody sputum, loss of weight or strength, night sweats, fatigue, etc. (A sputum examination was carried out in every case in which cough or expectoration was asserted, or râles of any description were heard on auscultation, except marginal râles.)

D. Existing cervical adenitis, tuberculosis of the bones or joints, or rectal fistula.

E. Asthenia and all cases in which the physical condition was manifestly below par; or lack of evidence of stamina or resistance to disease.

F. Cases of chest deformity; scoliosis, kyphosis, funnel chest, pigeon breast, flat chest and barrel chest.

G. Cases in which physical examination revealed:

1. Impaired resonance on percussion.

2. Increased transmission of voice sounds over areas in which these are not normally increased.

3. Abnormal breathing, such as sharpened vesicular or roughened inspiration, with prolonged expiration, over areas in which this was physiologically abnormal, even though no râles are detected.

4. All cases presenting râles, except marginal râles.

5. Fixation of lung borders or Turban shading.

If the examination as just indicated was distinctly negative and the preliminary examiner was of the opinion that there was no evidence of disease of the lungs, pleura or mediastinum, he accepted the man and indicated this action by placing his number in an assigned space on Form 88, M.D. This enabled us to determine the examiner who was responsible in any case brought to our attention later, and acted as a counter check on demobilization.

On the other hand, if the man fell into any of the above groups (A, B, C, D, E, F or G) the History Form 1 was initialed by the preliminary examiner who filled in the important data bearing on the case. He also wrote in the result of the physical examination. In case of abnormal physical findings, the preliminary examiner was obliged to record the results of inspection, percussion and auscultation. A diagnosis was required if a lung abnormality was noted. If tuberculosis was diagnosed, the examiner was obliged to indicate the character, location, extent and activity of the lesion. In case of other lung disease, sufficient evidence was given to justify the diagnosis. The preliminary examiner then checked for sputum examination, provided the man stated that he suffered from cough and expectoration, or if any kind of râles, other than marginal râles, were detected on auscultation. He wrote his recommendation to the president of the board and his reason for referring the case to the roentgenologists and refer examiners; such as, "family history," "past history," "physical findings," "chest deformity," "asthenia," etc. The preliminary examiner signed the blank and placed his number on Form 88, together with an "H" to indicate that a history had been written. The papers were then returned to the conscript, who passed them on to the clerks. They completed the history and sent the man in for fluoroscopic examination, which was carried out at once, the findings being typed on the history form, which was then sent to the refer examiner, who reviewed all the evidence; namely, the completed history, physical examination by the preliminary examiner and his diagnosis, and the roentgen-ray findings. The refer examiner then either accepted the man on accumulated evidence without examination, or the man was brought in for careful examination by the refer examiner.

If 1500 men were examined by the board a day, it is probable that from 300 to 400 fell into some of the above groups. All records of these men were gone over by the refer examiners, but all men were not reëxamined, as reëxamination of all refer cases was unnecessary. For instance, suppose in a given case the preliminary examiner found the lungs negative, but that there was a family history and contact history of tuberculosis, for which reason the man was referred; the refer examiner would accept the man without reëxamination, if the record showed the man to be working steadily, maintaining top weight, without cough or expectoration, in good general condition, good strength and roentgen-ray negative or revealing only an abnormality. However, if the roentgenologist diagnosed positive or suspicious tuberculosis or the man stated he was unable to work on account of sickness or loss of weight amounting to 10 per cent in the two years previous to entering service, although this might be attributed to hard work, the man was reëxamined. A reëxamination was done in nearly every case, irrespective of roentgen-ray findings, whenever the preliminary examiner noted a lung abnormality, whether diagnosed tuberculosis or not. In fact, reëxamination by the refer examiner was carried out in all cases when there was any evidence suggesting tuberculosis either in the past or present history, physical findings by the preliminary examiner or by fluoroscopic examination.

Rejections were made by the refer examiners only and always after reëxamining the man. Rejections were based on physical findings supported or unsupported by roentgenology. No man was rejected or diagnosed tuberculous on roentgenologic findings alone.

For demobilization purposes, this scheme was altered somewhat to meet changed conditions and to facilitate reference to records of men previously examined by the Camp Lewis Board, in order that a check-up could be made. (A complete report of this work will be published later.) For demobilization purposes, the following instructions were issued to the examiners on the Camp Lewis Board:

THE PLAN OF EXAMINATION AS CARRIED OUT BY THIS BOARD IS MODIFIED AS FOLLOWS FOR DEMOBILIZATION PURPOSES

Examiners will refer to Form 135-3 or 395-1 and note whether the officer or soldier claims to be suffering from the effects of any wound, injury, or disease or any disability or impairment of health that is directly or indirectly related to the lungs, pleura or chest wall. Next ask the officer or soldier whether he was mustered in this camp, when, and whether he was X-rayed in this building, thus indicating that he was referred to the refer examiner at that time. Consequently, a previous record of the officer or soldier is on file. Then, ask him if

he has been overseas, and if so, whether in zone of advance, suggesting possibility of having been gassed. He will be verbally interrogated regarding his family, past and present history, paying particular attention to the manner in which the officer or soldier stood up under military training. He will then be examined.

When a written record or blank history form is prepared, the examiner will always record the clinical history and physical findings upon which the diagnosis is based, and the reason the case is referred to the X-ray and refer examiner. He is also responsible for recording on this form all important data bearing on the base, leaving the remaining blank spaces to be filled in by the history clerks. If the officer or soldier is passed by you without reference to refer examiner, place your number in the space assigned to the tuberculosis team. If the officer or soldier was mustered and X-rayed in this building or passed through this board with his organization when it was examined, indicate this by placing a "P" (previous history) behind your number. If you write a history and the present history is the only one that has been written, indicate this by placing an "H" behind your number. If, in addition to the present history, there has been a previous one written, only your number is placed upon the blank card.

A written record on blank form will be prepared and the case sent to the X-ray and refer examiner under the following conditions:

A. Every officer or man claiming a disability of the lungs, pleura or chest wall on 135-1 or 395-4.

B. History of prolonged contact or death of a member of the family from tuberculosis, except in case the officer or soldier was mustered in this camp and historied upon admission, when it will not be carried out again.

C. Inability to keep up military duties on account of sickness or bad physical condition.

D. Every officer or man who gives a well defined history of previous pleurisy, pneumonia, typhoid or any other illness of a prolonged character which could have been tuberculosis during the five years prior to entering service, except in the case of officers or men mustering in this camp upon whom a record has been made and the officer's or man's physical condition is as good as upon acceptance for service.

E. Every officer or man not mustered at this camp claiming prolonged cough and expectoration, progressive loss of weight or strength, hemorrhage from lungs or expectoration of bloody sputum, either before entering service or after, and every officer or man mustering at this camp claiming above, since entering service.

F. Every officer or man who has had pneumonia, pleurisy, influenza, bronchopneumonia or other disease of the lungs or pleura which confined him to a hospital since entering service.

G. Existing cervical adenitis, tuberculosis of the bones and joints, or rectal fistula.

H. All cases of chest deformity, scoliosis, kyphosis, funnel chest, pigeon breast, flat chest and barrel chest, except those mustered in the camp and referred to X-ray and refer examiner upon entering service and where physical condition is not in a class lower than on entering service.

I. All cases wherein physical examination reveals:

1. Impaired resonance on percussion.

2. Increased transmission of voice sounds over areas where it is normally not increased.

3. Abnormal breathing, such as sharpened vesicular or roughened inspiration with prolonged expiration or bronchovesicular, over areas where it is not physiologically normal, even though no râles are found.

4. All cases presenting râles, except marginal râles.

5. Fixation of lung borders or Turban shading.

J. Every officer or soldier returned from overseas having been gassed or claiming to have been gassed.

K. Every officer or soldier who has received a wound of the thorax or neck, whether penetrating or not.

(Form 135-3 and 395-1 were forms which every officer and soldier signed prior to separation from military service. These forms were given to the soldier or officer by the discharge officer, as authority for examination, as shown on the Board's unofficial records.)

It will thus be seen that the system enabled us to check up our work fairly well. Moreover, the writer was not only President of the Tuberculosis Board, but camp tuberculosis specialist and President of the Discharge Board as well. In addition to the cases seen in these capacities, he saw every case occurring in the camp, and was, through the courtesy and coöperation of Capt. Thos. G. Clement, tuberculosis specialist at the base hospital, able to see every case transferred from the base hospital to other hospitals.

A further advantage accrued from the fact that the Ninety-first Division was under observation for ten months at Camp Lewis and then ordered overseas. During both this domestic service and subsequent overseas service, this division was accompanied and observed by Major Ray W. Matson, who was President of the Tuberculosis Board examining the first draft. Later it was largely demobilized at Camp Lewis by the board. The Thirteenth Division was examined and mobilized at Camp Lewis, and under observation six months, then demobilized. Thus we were able to compare entrance examinations with exit examinations of an enormous number of men who had been more or less under observation at home and overseas, from October, 1917, until August, 1919; and finally as a further check, records of 3000 patients at U. S. A. General Hospital No. 21 have been studied to determine place of mobilization, and whether or not they had been previously examined for tuberculosis, and by what board. (This report will follow later.)

Now, as to results, were the examinations worth while? Reference to the appended tables answers the question very decisively in the affirmative. Furthermore, the value was in direct proportion to the thoroughness of the work of the different tuberculosis boards, as well as the ideals and qualifications of individual members of the boards.

The rejection rate of the first million men was 0.873 per cent. The breakdown rate was 0.29 per cent. The rejection rate at Camp Lewis was 0.78 and the breakdown rate, 0.028 per cent. This difference in results is attributed to the general absence of check on examiners in the other camps.

Table 1 illustrates the comparative value of tuberculosis examinations by qualified and unqualified examiners before and after muster. The first draft sent to Camp Lewis comprised 37,000 men. They were given the usual physical examination formerly given recruits by medical officers assigned the mustering duty. It is not known how many cases

TABLE 1

Summary of Camp Lewis Examinations

CHARACTER OF MATERIAL	NUMBER EXAMINED	REJECTED FOR SERVICE BY TUBERCULOSIS BOARD CAMP LEWIS		TUBERCULOSIS CASES FOUND BY THE TUBERCULOSIS BOARD AFTER ENTRANCE INTO SERVICE DISCHARGED OR TRANSFERRED TO HOSPITALS						
				Not previously examined by Camp Lewis Tuberculosis Board.		Previously examined by Camp Lewis Tuberculosis Board				
						First draft		Second draft		
		Number	Per cent			Not historied	Historied	Not historied	Historied	Total
Referred by mustering officer at muster in examinations of 37,000, first draft	1,670	329	0.86							
Examination of command after muster, first draft	33,374*			372†	1.11	10	4‡			14
Regular Army organizations	2,610			18	0.68					
Second draft examined before muster	72,983	570	0.78					20	1	21
Demobilization: 63,575										
Previously examined at Camp Lewis	55,075					1		7§	1	9
Not previously examined at Camp Lewis	8,500			57	0.67					
Camp consultations; miscellaneous cases: breakdowns; mustered at other camps; not examined at Camp Lewis on entrance into service				38						
Total examined	174,212					11	3	27	2	

* Among the 3626 not examined out of 37,000, 9 cases of tuberculosis were found in General Hospital No. 21.

† 278 of these men were discharged by Discharge Board at Base Hospital, Camp Lewis.

‡ 1 case found in General Hospital No. 21, table 2, included.

§ 3 cases sent to General Hospital No. 21, table 2, included.

the latter rejected for tuberculosis, because only questionable cases were sent to the tuberculosis board, which acted as a refer board only. Of the 1670 cases referred by the mustering officer, 329 were found to be tuberculous and were rejected.

After the 37,000 were mustered, an examination of the command was begun by the tuberculosis board. However, only 33,374 were available, as the rest had already been sent away to fill up other organizations. Among the 33,374 men, 372 or 1.11 per cent cases of tuberculosis were found. These cases had of course been overlooked by the medical officers at muster in examination. Since these soldiers were already in service, they could not be rejected, but were transferred to the base hospital and discharged on certificate of disability, or transferred to the army tuberculosis hospitals. This not only put the government to the needless expense involved in equipping and training these men, and then caring for them, but also in compensating them. Many of these men had already been trained to fill important positions and had become valuable personnel; consequently, their early discharge disrupted the machinery and training of the organizations to which they were assigned. Special problems and "hikes" frequently had to be abandoned to allow groups of men in training to appear for examination.

A rejection rate of 1.11 per cent seems rather high at first thought. However, it is not high, considering the character of the material which came largely from the Southwest, and contained enormous numbers of health seekers who had been sent by the first draft boards, actually thinking change of climate and environment might benefit the manifestly tuberculous individual.

Of the 33,374 first draft men examined, 30,168 were accepted by the preliminary examiners on their own responsibility; among them, ten cases of tuberculosis developed. The preliminary examiners referred 3206 cases to the refer examiners, who rejected the 372 referred to above, as tuberculous (only refer examiners had authority to reject). Among the remaining 2834 accepted for service, 4 developed tuberculosis. Two of these cases occurred after four months' service, one broke down overseas and was returned to U. S. A. General Hospital No 21, (attention to this case is invited in connection with table 2), and the other case was accepted as a healed lesion, but six months later became active after an attack of measles.

The figures relating to the findings in a Regular Army organization reveal the percentage of tuberculosis we would expect to find in an

organization, none of whom had had other than the former usual enlistment physical examination. The percentage, however, is considerably lower than the rejection rate of the first million men.

The second draft examination comprised 72,983 men, of whom 15,831 came from the Southwest, and contained many health seekers. California, for instance, sent in the draft 13,995 men to Camp Lewis, among whom 178 or 1.27 per cent were rejected as tuberculous; whereas, Montana sent 10,250, of whom 42 or 2.4 per cent were rejected on account of tuberculosis. Still, the physical condition of these men was considerably better on the whole than the first draft, and the splendid work of the medical advisory boards was evident in preventing many cases of manifest tuberculosis from being sent to camp. Of the 72,983, 570 or 0.78 per cent were rejected as tuberculous. Twenty-five per cent of the rejects had tubercle bacilli in their sputum upon arrival at camp, no case having been seen by a medical advisory board.

Of the 72,413 accepted for service, the preliminary examiners accepted on their own responsibility 56,400, among which number 20 subsequently developed tuberculosis. Six of these cases were accepted by one incompetent examiner. Sixteen thousand five hundred and eighty-three were referred to the refer examiners, of whom 570 were rejected, as noted above. One of those accepted by the refer examiners developed tuberculosis. This case was accepted as an arrested lesion, but became active after an attack of influenza-pneumonia.

From a study of the 20 cases, occurring among those accepted by the preliminary examiners, it was evident that had instructions been followed, these cases would have fallen into the hands of the refer examiners, and would have been rejected.

The demobilization examination of 63,575 men, although even more painstaking and with of course an already well-trained and more experienced board, revealed only 66 cases of pulmonary tuberculosis. Our board had previously examined 55,075 of these men, the date of former examination ranging from three months to two years before. Among the 55,075 previously examined by the board, 9 cases or 0.016 per cent of pulmonary tuberculosis were found on demobilization (the average in all camps was 0.058 per cent). All of these men had rendered full military service. One was a first draft man accepted by preliminary examiners. Seven were second draft men accepted by preliminary examiners. (Three of these were sent to General Hospital No. 21, and included in table 2.) One was seen by a refer examiner, who considered

the case an arrested lesion upon entrance five months previously. In all, 214 cases of arrested tuberculosis were accepted; two became active. However, the following is a typical case of the type accepted, and performed full military service:

E. B. R., aged twenty-two, a private in the Infantry, entered the service June 24, 1918. His occupation was that of farmer,—working steadily. He was examined at Camp Lewis, June 26. There was no tuberculosis in the family. *Past history:* He stated he had typhoid fever in 1911, and had spat blood for three months before the onset of the fever (aspiration tuberculosis). *Present history:* He stated that he had a cough for three days. He said he had "caught cold" on the train, but he stated he had raised sputum from the lungs all his life. His strength was good. He had no night sweats or other complaints. *Examination:* His height was 65¾ inches; his weight was 131 (his highest weight); his general condition was good; the habitus was normal, and his attitude was active. The preliminary examiner reported the lungs negative. The man was sent to the roentgenologist and to the refer examiner on account of past history. *The roentgenologist reported:* "Marked increase in density left apex. This is not marked but rather even uniform density. Right apex illuminates much better than left on coughing. *Diagnosis:* fibrocaseous tuberculosis." (An unjustifiable fluoroscopic diagnosis from findings noted.) The sputum was negative. The refer examiner reëxamined the man and found impairment of percussion resonance, broncho-vesicular breathing, bronchophony, with narrowing of Kronig's isthmus over the upper part of upper lobe of left lung. There were no râles on expiratory cough. The *diagnosis* was: Healed tuberculosis.

The man was accepted for full military service and was soon overseas. He returned from overseas to Camp Lewis for demobilization, February 10, 1919. The soldier stated he had kept up his military duties and had had no sickness until he went into action in the Argonne, September 24, 1918, at which time he was gassed. He was sent to a field hospital. in which pneumonia developed, October 8, 1918. He was confined to hospitals until January 6. 1919, and was then sent home with a convalescent detachment. His weight at the time of demobilization was 138 pounds (seven pounds more than when he entered the service), but he weighed 150 pounds at the time he was gassed.

The preliminary examiner recorded that the general condition was good, the habitus normal, the attitude active, and the lungs negative. The man was sent to the roentgenologist and to the refer examiner because of the history of gassing. (All men stating that they had been gassed were sent to refer examiners.) The roentgen-ray examination was made by one of the refer examiners in this instance, who reported: "Fan-shaped area of increased density extending upward and outward from left hilum to apex. The left apex hazy and does not illuminate on coughing. *Diagnosis:* fibrocaseous tuberculosis."

Reëxamination of the man by a refer examiner revealed identically the same findings as noted on his entrance examination and a diagnosis of healed tuberculosis was made.

The two records were compared and since the man was accepted with a healed lesion and it had remained apparently the same, the man's general condition being even better, he was discharged with a notation made on the certificate of physical examination prior to separation from military service (135-3 A. G. O.) that a healed tuberculosis was present but existed prior to induction into military service and had not been aggravated. The soldier claimed no disability and none was given.

Had the refer examiner accepted the roentgenologic diagnosis, the man would have been an original reject, and the army would have been deprived of the services of an efficient soldier. On the other hand, had we not had a previous record of the case, or had some other method of examination been used, this soldier very likely would have been considered a case for one of the tuberculosis hospitals."

Of the 63,575 men examined on demobilization, 8500 had not been previously examined for tuberculosis by any board. These men belonged to the National Guard and various other organizations. Among this small group, 57 or 67 per cent with pulmonary tuberculosis were found, as shown above. This is practically the same percentage found in Regular Army organizations. Three cases of this group belonged to the 3626 first draft men mustered at Camp Lewis, but sent away before

TABLE 2

LARGEST CONTRIBUTION BY STATES TO CAMP LEWIS	TOTAL INDUCTIONS FIRST AND SECOND DRAFTS	NOT MOBILIZED AT CAMP LEWIS	MOBILIZED AT CAMP LEWIS: Total	MOBILIZED AT CAMP LEWIS: First draft and enlistments examined after entrance into service (incompletely examined)	MOBILIZED AT CAMP LEWIS: Second draft examined before muster. All examined	PATIENTS IN GENERAL HOSPITAL NO. 21, FROM CONTRIBUTING STATES TO CAMP LEWIS, STUDY OF 3000 CLINICAL RECORDS: Total	Not mustered at Camp Lewis	Mustered at Camp Lewis: First draft: not all examined: Not examined	Mustered at Camp Lewis: First draft: not all examined: Examined: Historied	Mustered at Camp Lewis: First draft: not all examined: Examined: Not historied	Mustered at Camp Lewis: Second draft: all examined: Historied	Mustered at Camp Lewis: Second draft: all examined: Not historied	Mustered at Camp Lewis: Total
California	67,067	27,865	39,202	25,207	13,995	62	60	2	0	0	0	0	2
Washington	28,686	8,140	20,546	7,478	13,068	42	37	3	1	0	0	1	5
Montana	27,340	8,168	18,172	8,922	10,250	6	2	3	0	0	0	1	4
Oregon	16,158	7,236	8,922	617	8,305	5	5	0	0	0	0	0	0
Idaho	12,566	4,081	8,485	2,478	6,007	3	3	0	0	0	0	0	0
Utah	10,788	4,327	6,461	2,600	3,861	4	4	0	0	0	0	0	0
Minnesota	73,680	68,545	3,135	33	5,102	16	15	1	0	0	0	0	1
North Dakota	18,595	16,183	2,412	22	2,390	5	5	0	0	0	0	1	1
South Dakota	21,255	19,255	2,000	3	1,997	6	6	0	0	0	0	0	0
Wyoming	7,923	6,962	1,971	?	1,971	9	9	0	0	0	0	0	0
Colorado	22,858	21,550	1,308	?	1,308	25	25	0	0	0	0	0	0
Totals	306,916	192,302	113,614	47,360	68,254	183	170	9	1	0	0	3	13

they were examined by the tuberculosis board. Camp consultations were comprised of cases picked up by me as camp tuberculosis specialist, from soldiers transferred from other places to fill up organizations at Camp Lewis. The number of troops from which these cases occurred is impossible to state. Few of these had been previously examined for tuberculosis.

Table 2 throws additional light upon the value of carefuly supervised tuberculosis examination.

Among 3000 records of the patients at U. S. A. General Hospital No. 21 studied, there were 183 from the contributing states to Camp Lewis who claimed they had been examined for tuberculosis by various boards. Of the 183, 170 were not mustered or examined at Camp Lewis, but at various other camps and places of mobilization in the area contributing to Camp Lewis. Of the 13 cases in General Hospital No. 21 who were mustered at Camp Lewis, 9 were breakdowns from the 3626 first draft men sent away from Camp Lewis, having been accepted by the mustering officer, but before they could be examined by the board. Three of these cases were picked up on demobilization by the Camp Lewis Board and transferred to the hospital. One was a first draft who had been examined and his discharge recommended by his company commander. The company was about to be transferred to another camp, and as this soldier was considered valuable to the company commander, he did not initiate the form necessary for discharge. Consequently, the soldier left Camp Lewis and was later sent overseas, where he broke down and was returned to the United States to General Hospital No. 21. This case is the only one occurring in the Ninety-first Division among those examined for tuberculosis by the Camp Lewis Board. Three cases were from the 56,400 accepted by the preliminary examiner without reference to the refer examiner. Study of these cases in the hospital made it evident that they should have been historied and referred, and undoubtedly would have been rejected.

Table 2, while accurate so far as the material studied at General Hospital No. 21 is concerned, is on the other hand only relatively accurate, because, of course, not all cases from the contributing states to Camp Lewis found their way into General Hospital No. 21; and while there was only one breakdown overseas in the Ninety-first Division, this case being sent to General Hospital No. 21, it is of course possible that certain troops examined at Camp Lewis and sent away to fill up other divisions could have developed tuberculosis, and found their way into tuberculosis hospitals other than General Hospital No. 21, and no record be available. Nevertheless, it is not probable that the breakdown among the smaller group, examined on entrance but not on demobilization at Camp Lewis and whose subsequent history is therefore unknown, was higher than among the 55,075 who had been examined by the board on entrance into service, and again on discharge, after having been under observation from three months to nearly two years. In other words, we know of 170 cases of tuberculosis that developed from among 192,302

or 0.08 per cent (there were of course many others we do not know about, as the average breakdown rate was 0.29 per cent for the army), as compared with 13 or 0.011 per cent we have traced back to the 113,614. While it could not be determined absolutely whether the 170 had actually been examined by a special board, it was determined that 9 of the 13 who claim they were examined at Camp Lewis had not been examined by the special board, but had received only the usual muster in examination. The same may have held true with regard to those mustered at other camps. It may be mentioned, then, in passing that an effort was made to verify statements as to whether the soldier was examined for tuberculosis or not.

Granting that there is the same large percentage of error in statements and clinical records of the 170 referred to above, and not mustered at Camp Lewis as among those who *were*, the balance is still very much in favor of Camp Lewis.

TABLE 3

Number cases in U. S. A. General Hospital No. 21

Studied	3000
Examined for tuberculosis on entrance into service	902
Not examined for tuberculosis until onset of present illness	2098

Table 3 is also only relatively correct, because it would appear that the 902 examined for tuberculosis upon admission into service are cases in which the disease was overlooked, when, as a matter of fact, study of these records shows that 590 are first draft men who were imperfectly examined, and the disease in many cases was found by tuberculosis boards after the men had been mustered into service. Being already in the service, they could not be rejected, as was done in case of the second draft, but were hospitalized. Absolute figures giving the number of the above cases who were examined by tuberculosis boards and passed, and later broke down, are not possible, because the information is not contained in the clinical records, and the patients themselves are unable to throw much light upon the problem. The balance of the 902, or 312, are second draft men. All were examined for tuberculosis and probably should have been rejected, judging from a study of the cases missed by the Camp Lewis Board. However, the table shows very clearly the value of the tuberculosis examination, because the percentage of breakdowns among the men who were not examined, constituting the small group, is enormously greater than the percentage of breakdowns from the large group that was examined.

It has been very clearly shown, I think, that the principles so outlined by Colonel Bushnell have been of value in eradicating tuberculosis from the army, and that the examinations were worth while. It is of national importance that the principles followed in the army examinations should be projected into medical practice of civil life, and that examination of working classes, etc., be undertaken. Pulmonary tuberculosis exists to an enormous extent in our cities, in our industries and in other institutions. Wheaton, in a survey of Chicago, found among 165,700 persons examined 2240 moderately advanced, and 323 far advanced cases of tuberculosis, or 1.34 per cent, which is about the percentage found in the first draft examinations. He found in various institutions from 8 to 20 per cent easily detected tuberculosis cases, and it is safe to assume that similar figures would be found in any city. As a matter of fact, whole communities could be examined by a dispensary organized along the lines used at Camp Lewis. It is, furthermore, most important that a juster attitude be taken regarding the diagnosis of early tuberculosis in civil life. Undoubtedly, if our medical students and physicians were taught these principles, fewer mistaken diagnoses of pulmonary tuberculosis would be made on the erroneous interpretation of either topical variations of normal physical signs or misinterpretation of physical signs, due to other diseases.

Grateful appreciation for valuable assistance is hereby acknowledged to my assistant on the Camp Lewis Board, Contract Surgeon B. R. Wallace, and to other members of the Board, to Capt. Thos. G. Clement, former Tuberculosis Specialist, Base Hospital, Camp Lewis, and later Assistant Chief of Medical Service, U. S. Army General Hospital No. 21; and also to members of the Medical Service and Miss Ruth Bond of General Hospital No. 21, for valuable assistance in collecting data from patients and from clinical records.

REFERENCES

(1) Matson, R. C.: Examination of recruits for tuberculosis. New York M. J., Aug. 3, 1918, 199, and Aug. 10, 1918, 245.

(2) Matson, R. C.: Value of chest fluoroscopy. J. A. M. A., 1919, lxxii, 1887.

THE CLASSIFICATION OF PULMONARY TUBERCULOSIS BASED UPON SYMPTOMS AND PHYSICAL AND X-RAY FINDINGS

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The classification of pulmonary tuberculosis has always been unsatisfactory and, since it is impossible to exclude entirely the personal equation, it probably always will be so. The modification of the National Tuberculosis Association's classification suggested by Rathbun and adopted by the American Sanatorium Association is an attempt to reduce the error due to the personal equation. While the classification of the National Tuberculosis Association depends upon both physical signs and symptoms, the classification of the American Sanatorium Association depends primarily only upon physical signs and subdivides the incipient, moderately advanced and far advanced groups into three other groups, depending upon symptoms. It has long been recognized that any classification that rested upon physical signs was very likely to be erroneous, for physical signs, though they tell only what has happened and not what is happening, do not always tell the whole story. In fact, many have come to believe that, accepting a diagnosis of pulmonary tuberculosis, the symptoms reveal what is happening at the time of examination and consequently of classification. These facts have long been known, and even Turban, whose classification based on physical findings has been most widely used, recognized that it did not wholly suffice. Be this as it may, to the majority of workers in pulmonary tuberculosis it has appeared that a classification based on the extent of the pulmonary disease is to be preferred to all others.

In another communication we have attempted to show that the inferences in regard to the extent of disease drawn from the study of physical signs may greatly mislead. In 48 per cent of the 814 instances, the disease was more extensive than the inferences, drawn from the physical signs, would suggest.

For these reasons it has seemed worth while to us to suggest that the classification, based primarily upon the extent of pulmonary disease,

should rest not only on the notoriously uncertain physical signs, but also upon the extent of disease as shown by X-ray plates. We therefore suggest that the following additions be made to existing definitions:

1. To the definition of Incipient (or Minimal):

X-ray findings to show a total area involved (parenchymatous) not greater than the area to the upper level of the 2nd chondrosternal junction on one side (both sides may be involved) in the form of scattered mottling, or an intense shadow interpreted as pleuritic.

2. To the definition of Moderately Advanced:

X-findings to show an intense shadow, not interpreted as pleuritic, of no greater extent than the area above the upper level of the 4th chondrosternal junction on one side; or areas of rarefaction interpreted as cavities limited to one interspace; or scattered mottling over a greater area than under Minimal, but not greater than the area of one entire lung and to the level of the 2nd chondrosternal junction on the opposite side.

3. To the definition of Far Advanced:

The X-ray to show an intense shadow, not interpreted as pleuritic, of greater extent than the area to the level of the 4th chondrosternal junction, or areas of rarefaction interpreted as cavities, greater than one interspace, or scattered mottling greater in extent than under Moderately Advanced.

The classification of any case would be made either by physical signs or by X-ray findings, selecting the one that revealed the greater extent of disease. This should of course be indicated by P. S. in brackets when the classification depends upon physical signs, or by X-R in brackets when it depends upon X-ray plates.

We would also suggest that, even when the symptoms fall in the incipient group (Group A), the case may nevertheless be active, and even in the moderately advanced group the disease may be inactive. Hence, it seems to us wise to consider whether it is well to attach the letters A or I, indicating "active disease" and "inactive disease," to each record. We fully realize that it might be well to define these terms more fully before accepting such additions to the classification.

The term *Incipient* has long been a stumbling block. The word implies time, and, as used in our classification, it ignores time. For example, a patient may go to Colorado and be classified as Moderately Advanced. After a year's residence he may return east for a change and seek admission to another institution. While in Colorado he may

have improved so much that, on his return, it would be necessary to classify him as Incipient. The whole struggle about the definition of the incipient group was to make it define a type of case that was in a stage about as early as any in which a positive diagnosis could be made. For these reasons it seems to us that the term *Minimal* would express this idea far better, and for future workers remove the stumbling block of time; for they would no longer wonder how disease of ten or more years duration could be called incipient.

CLASSIFICATION OF PULMONARY TUBERCULOSIS

1. *On Admission.*

These definitions indicate the furthest extent of disease and the greatest severity of symptoms that a patient can present and still belong to the stage defined. All patients beyond the minimal stage fall in the moderately advanced stage, unless the physical signs, X-ray findings and symptoms exceed those of the moderately advanced stage, when they should be classified as far advanced.

Minimal. Slight or no constitutional symptoms (including particularly gastric and intestinal disturbance or rapid loss of weight), slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours.

Expectoration usually small in amount or absent.

Tubercle bacilli may be present or absent.

Slight infiltration limited to the apex of one or both lungs, or a small part of one lobe.

X-rays findings to show a total area involved (parènchymatous), not greater than the area to the upper level of the 2nd chondrosternal junction on one side (both sides may be involved) in the form of scattered mottling, or an intense shadow interpreted as pleuritic.

No tuberculous complications.

Moderately Advanced. No marked impairment of function, either local or constitutional.

Localized consolidation moderate in extent with little or no evidence of cavity formation; or infiltration more extensive than under Minimal.

The X-ray to show an intense shadow, not interpreted as pleuritic, of no greater extent than the area above the upper level of the 4th chondrosternal junction on one side; or areas of rarefaction interpreted as cavities limited to one interspace; or scattered mottling over a greater area than under Minimal but not greater than the area of one entire lung and to the level of the 2nd chondrosternal junction on the opposite side.

No serious complications.

Far Advanced. Marked impairment of function, local or constitutional.

Marked consolidation of an entire lobe.

Or disseminated areas of beginning cavity formation.

The X-ray to show an intense shadow, not interpreted as pleuritic, of greater extent than the area above the upper level of the 4th chondrosternal junction of one side, or areas of rarefaction interpreted as cavities, greater than one interspace, or scattered mottling greater in extent than under Moderately Advanced.

Or serious complication.

Miliary tuberculosis.

2. *On discharge.*

Apparently arrested. All constitutional symptoms and expectoration with bacilli absent for a period of three months; the physical signs and X-ray findings to be those of a healed lesion.

Quiescent. Absence of all constitutional symptoms; expectoration and bacilli may or may not be present; physical signs and X-ray findings to be stationary or retrogressive; the foregoing conditions to have existed for at least two months. It must be borne in mind that increase of physical signs with lessening of symptoms and improvement of general condition may occur in quiescent cases. However, in these cases the X-ray must show a stationary or retrogressive condition. The length of time mentioned is, of course, somewhat arbitrary, but it is intended to cover the cases which frequently occur where the patients leave a sanatorium for various reasons, contrary to advice, after a stay of a few weeks, although all active symptoms may have ceased completely soon after entrance.

Improved. Constitutional symptoms lessened or entirely absent; physical signs and X-ray findings improved or unchanged; cough and expectoration with bacilli usually present.

Unimproved or Progressive. All essential symptoms, physical signs and X-ray findings unabated or increased.

Died.

3. *Ultimate results.*

Apparently Cured. All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

Well. Patients who fulfill all the conditions required under Apparently Cured but about whose sputum no definite information can be obtained.

Arrested. See Quiescent above.

Improved. See above.

Progressive. See above.

Dead.

DEFINITION OF TERMS

Terms used in definition of minimal.

1. *Slight constitutional disturbance.* Slight loss of appetite, of strength, of weight; lassitude; possibly slight acceleration of pulse or possibly slight elevation of temperature. The impairment of health may be so slight that the patient does not look or feel sick in the ordinary sense of the word.

2. *Slight elevation of temperature.* Maximum temperature after rest for one hour never over 99.5° to 100°F. by mouth (or 100.5° per rectum).

3. *Slight acceleration of pulse.* Maximum pulse rate not over 90 after rest for one hour, sitting or lying, except when due to causes other than tuberculosis.

4. *Absence of tubercle bacilli.* Each monthly examination (if the sputum be negative) to consist of a careful microscopic examination, with a mechanical stage, of two smears, devoting at least three minutes to each smear, made from selected particles (at least six from different parts) of the sputum on each of three successive days. The morning sputum should always be obtained, or, better, the minute bits that some arrested patients raise at very infrequent intervals. It is not yet deemed wise to insist on digestion and centrifugalization or on inoculation of guinea pigs.

5. *Physical signs of infiltration.* Slight prominence of the clavicle, lessened movement of chest, narrowing of apical resonance with lessened movement of base of lung, slight or no change in resonance, distant or loud and harsh breathing, with or without some change in the rhythm (that is, prolonged expiration), vocal resonance possibly slightly increased; or fine or moderately coarse râles present or absent. If sputum contains tubercle bacilli, any one of these.

6. *Apex.* That portion of the lung situated above the clavicle and the third vertebral spine.

7. *A small part of one lobe.* An area of one or two intercostal spaces, or an area not exceeding 60 to 80 sq. cm. in extent, according to the size of the patient.

Terms used in definition of moderately advanced.

1. *Marked impairment of function, either local or constitutional.* Local: Marked dyspnea on exertion limiting seriously the patient's activity. Constitutional: Marked weakness, anorexia, tachycardia.

2. *Moderate extent of localized consolidation.* An area of one half lobe or less, but may involve both apices; marked dulness, bronchial or decidedly bronchovesicular breathing; markedly increased vocal resonance; râles usually present. These signs to be sharply limited as to area instead of gradually shading into normal physical signs.

3. Evidence of destruction of tissue. Presence of tubercle bacilli or elastic fibers in the sputum or the presence of the physical signs of a cavity. There are no absolutely certain physical signs of cavity but a combination of any four of the following signs is to be taken as indicative of a cavity: (1) cracked-pot note; (2) amphoric breathing; (3) intense whispering pectoriloquy; (4) a veiled puff or post-tussive suction; (5) bubbling râles. "Physical signs of softening" do not admit of any definition apart from that of cavity formation, and the term should not be used.

4. Disseminated fibroid deposits. More or less localized areas of fibrous tissue, producing on physical examination some change in dulness in the percussion note, more or less increase of vocal resonance, harsh, suppressed, or bronchovesicular breathing, râles sibilant or sonorous usually, but at times fine and moderately coarse.

5. Serious complications. These should be limited to tuberculous complications, such as meningitis, pharyngitis, laryngitis (except slight thickening of the posterior interarytenoid space, and superficial ulceration of a vocal cord), enteritis, peritonitis, nephritis, cystitis, orchitis, adenitis (unless very slight), etc.

Terms used in definition of far advanced.

1. Marked consolidation. Indicates dulness merging into flatness, bronchial or tubular breathing and other signs of consolidation as defined in paragraph 2, Moderately Advanced.

Definition of terms used in X-ray classification.

These conditions are judged from plates (negatives) and not from fluoroscopic screen or photographic prints (positives).

1. Mottling. Characterized by numerous various sized transparent or translucent spots with ill defined margins, usually fusing with one another; or the small spots may be scattered and may be discrete, though usually they have ill defined margins and tend to fuse with surrounding shadows. The term *mottling* is not to be used to describe isolated small densities where they can almost be counted. The term *mottling* implies numerous tubercles.

2. Intense shadow. An area or areas (of an interspace or more) of almost transparency. This is to be intrapulmonary and if possible differentiated from pleuritic changes which may also cast an intense shadow. The mammae, the pectorales and the sternocleidomastoid muscles are often confusing but can be differentiated by proper technique. The character of an intense shadow is about like that cast by the heart.

3. Area of rarefaction. Characteristic areas of rarefaction are the lumen of the trachea in the mediastinal shadow or a bleb of gas in the fundus of the stomach. These areas transmit more X-ray when compared with the

shadows cast by the tissues in the immediate neighborhood. These areas of rarefaction reveal a diminution or complete absence of lung markings and imply intrapulmonary cavity. Very often overlying shadow-producing tissue and pathological changes (thickened pleura) make the detection of an area of rarefaction difficult. Annular shadows are to be differentiated if possible.

Terms used in definition of apparently arrested.

1. *Constitutional symptoms.* These include elevation of temperature, loss of weight, loss of strength, night sweats, chills, tachycardia, cyanosis, loss of appetite, amenorrhea, etc.

2. *Physical signs of a healed lesion.* These may embrace every physical sign of infiltration or consolidation (see paragraphs 5 Minimal and 2 Moderately Advanced) with the exceptions of râles, which must be permanently absent, except possibly a few fine râles at the base, probably atelectatic in origin, and at one apex or over a small part of one lobe. Râles in the latter two places are to be heard only during the cough, at the end of a prolonged expiration, or during the inspiration which follows the cough.

3. *X-ray findings in a healed lesion.* The condition to be stationary or retrogressive for the preceding three months.

Terms used in definition of improved.

1. *Constitutional symptoms lessened or entirely absent.* By this is meant an improvement in the general condition as shown by a gain in *both* weight and strength or by reduction of previous febrile temperature to normal without loss of strength.

Terms used in definition of unimproved or progressive.

1. *Essential symptoms and signs.* These include, among others, weight, strength, appetite, night sweats, hemoptysis, pleurisy, dyspnea, temperature, pulse rate, dulness, changes in vocal resonance and respiratory movement, râles.

Terms used in definition of apparently cured.

1. *Ordinary conditions of life.* This term as used implies that the patient is able to live in an environment where he is able to support himself without the assistance of others, or to live in his former surroundings and pursue his former occupation.

THE CLASSIFICATION OF PULMONARY TUBERCULOSIS AS MODIFIED BY STEREOSCOPIC ROENTGENOGRAMS[1]

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A review of the literature of recent years upon the diagnosis of pulmonary lesions, especially that referring to the value of the roentgen ray, is interesting. In the earlier contributions of clinicians there may be found expressions of doubt; and even the most enthusiastic radiographers, absorbed in the technical development of their art and strange to the new method of examination, were unprepared to insist upon its accuracy or the interpretation of their findings.

With more general use of the fluoroscopic screen and photographic plates, and rapid improvement in technical methods, a new note of assurance appears in the discussions of the relative value of established methods of examination by the clinician and the newer one of the roentgenologist, in the diagnosis of early pulmonary tuberculosis. At this period the former had learned, often by discomfiting experience, that roentgenograms *could* disclose cavities of size which he had missed and gross lesions, generally, the extent of which he had not suspected; while the latter was beginning to realize that many appearances of infiltration and even definite shadows, were not accompanied or followed by the symptoms of clinical tuberculosis. But with a tenacity almost pathetic, the clinician on the one hand, is often found still opposing the inference that classic procedures in the physical examination of the chest are not sufficient, or even superior for the diagnosis of early lesions; and indeed he is often rewarded by the failure of the radiograph to disclose them in patients unquestionably tuberculous, while on the other, the roentgenologist, with an eagerness and assurance born of conscious possession of new and valuable methods of study, contends for the significance of slight variation from the normal intensity of linear markings and peribronchial or localized parenchymatous shading.

[1] Read before the Clinical Section of the Sixteenth Annual Meeting of the National Tuberculosis Association, St. Louis, Missouri, April 23, 1920.

In 1916, Minor (1) in a splendidly fair discussion of the subject, while maintaining that "the solution of the question of the exact diagnostic value of the X-ray is not yet possible," conceded it to be indispensable in determining the character and extent of grosser or deeply placed lesions, admitted that "in a few difficult cases the stereoscopic plate is needed for a final diagnosis," and urged the routine use of the fluoroscope, and, for more leisurely study and permanent record, stereoscopic plates.

Since then much careful and illuminating study has been given to the interpretation of roentgen findings, especially by radiographers, with the effect of more firmly establishing their case, in the course of which the further perfection of their technical methods and the use of stereoscopic plates have been most important factors.

While it is true that even so recently as 1919, Walsh, Wood and Thompson (2) reported experimental work tending to the conclusion, among others, that "much of the teaching and speculation in regard to X-ray shadows in connection with tuberculosis of the lungs is far from correct as is proved by autopsy," they are in agreement with the majority of clinicians and roentgenologists alike, in the expression of their opinion that "the best results are achieved by careful diagnosis compared with the X-ray plates, and, if differences are found, submission of these to physical examination before conclusion is reached."

For several years it has been the custom at Loomis Sanatorium to make and study stereograms of each patient, but no critical comparison of these findings with those of the physical examination was made as a routine procedure until December, 1918. Since then, with the hope of contributing to this important subject, and with the thought that such comparison might modify somewhat the classification of our patients, which prior to that time had been determined solely upon the character and extent of the pulmonary lesion as revealed by physical signs, 100 patients and at least one set of stereograms of each have been studied in the following manner:

The initial physical examination of approximately all of them has been made by one of us (W.) and quite independently of the results of this the stereogram of each has been read by the other (A.). In a few instances only the physical examination as well as the interpretation of the plates has been done by the same examiner (A.), but in every instance the original physical examination has been checked up at least one month later either by the other author (W.) or by other members of the medical staff. At their stated conferences each case has been reviewed, the

stereogram again studied, the findings compared with those of the original and later physical examinations, and, if necessary, a reclassification made, in the determination of which the history and clinical symptoms have been given their proper values. In a few instances, when very marked discrepancies were apparent in these critical reviews, the physical examination was repeated and all obviously defective plates were rejected and new ones made.

The patients studied have been, with few exceptions, of the moderately or far advanced type and do not, therefore, present sufficient data for conclusions relative to the advantage of either method in the diagnosis of slight abnormalities of doubtful character or of early (incipient) tuberculosis. Nor in lesions of the latter type, or even in those of more advanced degrees, are we prepared to contend that the stereogram alone gives us more dependable information as to their activity than physical examination alone. We are inclined to believe, however, that very frequently indeed the stereogram discloses areas of conglomerate tubercles in the lung parenchyma so well described by Minor (1) as "cloudy masses floating over the lung picture like a sea fog blowing over the land," which have not given auscultatory evidence of their existence, and even before any unfavorable clinical symptoms have suggested active progressive disease; and we do share his opinion that these "are uniformly connected with advancing and active trouble."

There seems to be no question, however, that stereograms are indispensable in determining accurately the anatomical distribution and pathological character of the more advanced pulmonary lesions of tuberculosis, and that frequently enough, to be of the greatest value not only in guiding the management of patients but also in determining the formal classification of cases, the stereogram clearly pictures conditions which physical examination entirely fails to indicate or very imperfectly discloses.

At present we desire to consider this conclusion with reference to classification only. At Loomis certainly, and probably at other sanatoria also, patients have been classified according to the findings of physical examinations alone with, as we believe, a considerable factor of error, and to the extent that this has obtained, the published statistics of such institutions are inaccurate, their patients, on admission and probably also on discharge, being in more advanced stages of their disease than is apparent. In some measure, therefore, the beneficial influence of sanatorium care receives less credit than it deserves and the satisfactory return of health enjoyed thereafter by so many tuberculous persons assumes a new significance.

Any classification of tuberculous patients is of necessity an arbitrary one and that now in general use, though unsatisfactory in some respects, has served its purpose well. Since, however, the stereoroentgenogram has demonstrated its value as an accessory method of investigation in any physical examination which purposes to be searching and complete, and since its findings so frequently and materially modify the conceptions of the lesion which are based upon physical signs alone, it seems proper that they should share in the determination of the classification.

Errors in physical diagnosis are only too frequent. The cause of these errors is a matter of physics and will not be discussed here; suffice it to say that our mistakes fell curiously into several groups.

TABLE 1

General results

	NO. OF CASES	PER CENT
Original classification unmodified	67*	67
Original National Association classification unmodified. Original Turban classification modified	12	12
Original National Association classification modified. Original Turban classification unmodified	5	5
Both National Association and Turban modified	16	16
Total	100	100

* Of the first group of 67 cases, there were 41 in which no revisions whatsoever were made. In the remaining 26 there were minor changes, which, however, were not sufficient to alter the final stage. These changes which were in the details of the Turban classification, were as follows:

Early, patulous walled cavities, some of them quite large, often were not discovered on physical examination. When cavities were old with fibrotic walls, they were usually noted.

Deep seated infiltration, especially of the hilum and lower lobe type, without moisture, was another source of error. Usually the lesion was discovered but its extent was not suspected.

In a small group of cases slight changes in breath sounds with râles were erroneously interpreted as evidence of tuberculosis.

In a still smaller group fibrosis was mistaken for cavitation.

All cases were grouped on admission according to the classification of the National Tuberculosis Association and that of Turban. The roentgenological diagnosis was subsequently made according to Turban and the schema suggested by Heise and Sampson (3).

The revised grouping adopted by the staff conference was similar in form to the admission classification.

The immediate results of the study are shown in tables 1 and 2.

These figures, showing that more than three-quarters of the minor changes were made within the Turban III group, emphasize, in passing, the too great inclusiveness of that group.

In 14 of the first group of 67, the X-ray classification differed slightly from the clinical. In these cases, however, the clinical classification was considered more nearly correct.

A study of these tables shows, first, that although in the large group, so far as classification is concerned, roentgenology had only a confirmatory bearing, there is a very considerable group in which it was responsible for modifications of the classification, and its ultimate influence upon the management of a given case requires no emphasis. Intelligent treatment presupposes an accurate estimate of the extent and character of the lesion and our experience indicates that the stereogram is necessary for such an estimate in 20 to 30 per cent of the cases.

TABLE 2

Minor alterations

TURBAN	RIGHT SIDE	LEFT SIDE	BOTH SIDES	TOTAL
Stage I		2		2
Stage II	2	3	1	6
Stage III	11	5	2	18
	13	10	3	26

The tables show, further, that most of the discrepancies occurred in that group of cases which on admission were classified in the moderately advanced and Turban II groups. Sixteen of 47 patients admitted as moderately advanced were shifted to the far advanced class and 22 of 40 cases assigned to the Turban II group were transferred to Group III after a review of the Roentgen findings. These figures indicate the value of the stereogram in determining especially the proper classification of cases considered moderately advanced on physical examination.

It is obvious that roentgen findings necessitate very little change in the classification of those patients whose lesion is unquestionably so extensive as to determine their assignment to the far advanced or Turban III group. Here the precise diagnosis usually is not difficult and the technical definitions of the group are so wide as to allow for a liberal margin of error.

TABLE 3

National Association classification

ON ADMISSION	CLASSIFICATION MODIFIED	CLASSIFICATION UNMODIFIED
	per cent	*per cent*
Of 9 incipient	3	6
Of 47 moderately advanced	16	31
Of 44 far advanced	2	42
Total percentage	21	79

TABLE 4

Details of National Association classification modification

	NO. OF CASES
Incipient changed to moderately advanced	3
Moderately advanced changed to far advanced	16
Far advanced changed to moderately advanced	2
Total number of cases	21

TABLE 5

Turban classification

ON ADMISSION	CLASSIFICATION MODIFIED	CLASSIFICATION UNMODIFIED
	per cent	*per cent*
Of 13 stage I cases	6	7
Of 40 stage II cases	22	18
Of 47 stage III cases	0	47
Total percentage	28	72

TABLE 6

Details of Turban modification

	NO. OF CASES
Stage I changed to stage II	4
Stage I changed to stage III	2
Stage II changed to stage I	1
Stage II changed to stage III	21

An amended classification has already been proposed. While our study was in progress we learned with gratification that a similar investigation was being conducted by our colleagues at Trudeau. The first fruits of their work were presented at the midwinter meeting of the American Sanatorium Association in December, 1919. Their immediate conclusion was that roentgen examination is indispensable in diagnosis and they then suggested a tentative classification which incorporated its findings and which is based on the National Association schema. The proposition is a forward step and the Trudeau investigators are to be congratulated for its creation. Our experience, however, prompts us to suggest several alterations that might be advantageous in such a classification and, in connection with this paper, we present criticisms of it which we hope are constructive.

Our studies indicate:

1. That in 33 per cent of the cases the precise character and extent of the pulmonary lesion were not determined by physical examination alone.

2. That in 21 per cent the roentgen findings necessitated modifications of the National Association classification, and in 28 per cent that of Turban.

3. That modifications were required chiefly in the moderately advanced and Turban II groups, but that the influence of the stereoscopic examination was evident in all groups.

4. That the roentgen findings should share in the determination of the classification of pulmonary tuberculosis.

In conclusion the following alterations of this proposed classification on admission embody our ideas with regard exclusively to the roentgen findings. They are submitted with comment not as a classification, but to present our suggestions in a formal way:

Minimal. Roentgen findings to show a total volume of involvement interpreted as parenchymatous infiltration not greater than the volume of lung included above the level of the second chondrosternal junction of one side (both sides may be involved) or an intense shadow interpreted as pleuritic.

Moderately advanced. Roentgen findings to show an intense shadow interpreted as patches of consolidation, or dense infiltration or massive fibrosis not greater in extent than one-third the volume of one lung; or areas of rarefaction interpreted as cavities the extent of which shall not exceed the width of the first rib at the level of the clavicle; or moderate

parenchymatous infiltration greater than under minimal (moderately heavy mottling) or fibrotic deposits disseminated through not more than the volume of one lung; or light parenchymatous infiltration which may be disseminated throughout both lungs. There is usually a combination of these, but their estimated totality is not to exceed the volume of one lung, unless the lesion be of the light and disseminated type.

Far advanced. Roentgen findings to show more involvement than under Moderately Advanced. All patients with pneumothorax, unless it is slight and localized, to be classed as far advanced.

An effort has been made, wherever possible, to specify terms positively, believing their meaning to the roentgenologist will be accordingly more definite. "An intense shadow, not interpreted as pleuritic" defines the meaning negatively and it seems better to say "an intense shadow, interpreted as dense infiltration, consolidation or fibrosis."

We have substituted the term "volume" for "area." It is well to consider that the purpose of the stereogram is to enable us to visualize the lung in its three dimensions and that lesions also must be so conceived.

Under "moderately advanced," our colleagues have considered particularly the character of the lesion and the extent of the infiltration allowable and have designated certain limits. But the intensity of the infiltration is also of great importance. We hold that the factors, intensity and extent, stand roughly in an inversely proportional relation and that both factors are essential in formulating the final estimate of the severity of the lesion. We have attempted, therefore, to give each factor due weight, allowing wide distribution where the intensity is slight.

In stating the extent of lesion allowable, we have used the volume of one lung as a unit and have defined all volumes in terms of this unit. Obviously, such a scheme omits the factor of location, and includes all lesions, whether of the apical, hilum or basal type.

It seems preferable to specify the diameter of cavity, allowable in the moderately advanced class, according to some convenient anatomical constant. The intercostal spaces are notoriously variable in width and we have, therefore, suggested as a constant the width of the first rib at the level of the clavicle. This, we believe, will answer the relative requirements of all cases and is little subject to pathological variations.

The most difficult problem is to determine the amount of infiltration, consolidation, cavitation and fibrosis which may exist in combination in cases classed as moderately advanced. The limit we have set is of necessity arbitrary but, according to our experience, reasonable.

It is also desirable to provide a place for the patient with spontaneous or induced pneumothorax. Because of the special treatment demanded and risks entailed, pneumothorax should probably be regarded as a serious complication, automatically placing it in the far advanced class.

It is obvious, that some of our definitions of the roengten findings necessitate alterations in the definitions of some physical signs.

REFERENCES

(1) Minor, C. L.: The use of the X-ray in the diagnosis and study of pulmonary tuberculosis. Nat. Tuberc. Assoc. Tr., 1916, 149.

(2) Walsh, J., Wood, J. W., and Thompson, J. C.: X-ray study of advanced tuberculosis of the lungs with autopsies. Nat. Tuberc. Assoc. Tr., 1919, 69.

(3) Heise, F. H., and Sampson, H. L.: The classification of pulmonary tuberculosis, with a comparative analysis of the different methods employed. Amer. J. Roentgenol., 1918, v, 139.

INTESTINAL TUBERCULOSIS[1]

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Until recently, when mention was made of tuberculosis of the intestines, we all thought of a terminal complication of pulmonary tuberculosis, for which little was to be done and to which a fatal termination could almost invariably be expected. The reason for this widespread belief is found in the fact that the diagnosis of this complication was made only when the condition was far advanced and the symptoms well established, and also because we looked for this complication only in cases of far advanced pulmonary tuberculosis.

More recently our ideas of tuberculosis of the intestines have undergone a change and it has now taken an important place among the complications of pulmonary tuberculosis, which may arise at any stage of the lung disease. We are also learning to recognize it in its early stages before it becomes generalized through the intestines, and at a time when there is something to be hoped for and expected from treatment. In many cases of pulmonary tuberculosis with slight digestive disturbances we now know that ulceration of the intestinal tract is at the bottom of these symptoms, and that if it is possible to relieve the abdominal condition the pulmonary trouble will heal much more rapidly and surely. Any disturbances of the gastrointestinal tract which interfere with the proper assimilation of nourishment are of the very greatest importance in the treatment and prognosis of pulmonary tuberculosis, as recovery is largely dependent on a proper and adequate supply of food, which is fully digested and utilized to counteract the drain on the system caused by the disease.

It is difficult as yet to tell with any degree of accuracy in what proportion of cases these intestinal complications occur. Autopsies show that in about 75 per cent of cases dying with pulmonary tuberculosis ulcers of the intestines, of greater or less extent, are found. Some pathologists would put this figure even higher. It is certain, however, that

[1] Read before the Medical Society of the County of Albany, April 13, 1920.

clinically we do not find symptoms of intestinal involvement in anything like such a large percentage of our pulmonary cases. Even in the advanced stages, granting these figures to be correct, we must assume that a great deal of this intestinal ulceration is latent from a clinical standpoint and produces no recognizable symptoms. This bears out what is now being found by the routine X-ray examination of the intestinal tract of persons suffering from pulmonary tuberculosis. In a good many cases it is found that X-rays of a barium meal give what we now consider to be a typical picture of intestinal tuberculosis, while the patient is not suffering from clinical intestinal tuberculosis, and has not the symptoms usually associated with this complication. The study of intestinal tuberculosis is thus not so simple as we have been taught to think, and further investigation is necessary to recognize the borderline cases in which the classical symptoms are not present.

The lesions which are found in intestinal tuberculosis are chiefly ulceration and a certain amount of fibrosis or inflammatory thickening around the ulcers. The ulcers arise from a breaking down of the lymphoid follicles, and in the small intestine are apt to be larger in size than in the large intestine. In the large intestine, especially in the recent conditions, the ulcers are usually small, about 1 cm. or less in diameter, and are scattered fairly thickly throughout the mucosa. The edges are raised or heaped up giving the ulcers a crater-like appearance. There is frequently a certain amount of plastic exudate on the peritoneal surfaces overlying the base of the ulcer, and frequently subperitoneal tubercles are seen. The glands in the mesentery are usually somewhat enlarged. The favorite site of ulceration is the lower end of the ileum and the caecum. Next in frequency are the flexures of the large intestine, hepatic, splenic or sigmoid. In many cases, unfortunately, the ulcers are widespread, extending from the lower end of the duodenum right through to the rectum.

There are many points in connection with the etiology of intestinal tuberculosis which are not yet solved. It has been the custom to ascribe the origin of these ulcers to bacillus-laden sputum which is swallowed voluntarily of involuntarily, as must occur in every case of open pulmonary tuberculosis. The finding of tubercle bacilli in 90 per cent of the stools of patients with open tuberculosis of the lungs gives some support to the theory that the infection takes place directly from the passage of the bacilli in the sputum through the intestinal mucosa. This theory does not explain many of the phenomena which we find and there

is a certain amount of evidence that the infection arises in many cases by the blood stream, the bacilli gaining entrance to the circulation from the lungs and being carried to the intestines by the mesenteric arteries. This must certainly be so in the cases with widespread ulceration where the ulcers are all apparently of about the same age, but it is difficult to understand why a localized caecal tuberculosis should arise in this way. We are also ignorant of the factors which would tend to cause the bacilli to enter the mesenteric arteries and not other arteries of the systemic circulation. This same question arises in cases of renal, joint or meningeal tuberculosis, although it is generally accepted that these complications are haematogenous in origin.

In many cases, suspicions of intestinal complications may be aroused by the observation that a patient is not as well in a general way as he was previously, although the signs and symptoms referable to the lungs are stationary or improving. This apparent improvement of the lungs associated with the development of the disease in the intestines has been frequently noted, as it has been during the development of complications elsewhere in the body, there being an apparent compensatory reaction. In some cases a decrease in the amount of expectoration and diminution in the extent and coarseness of the râles may be accounted for by a draining of the system by the diarrhoea, but in others this is not sufficient to explain the fact.

At the onset there is usually an increase in the general symptoms, fever, general malaise, loss of weight, and so forth; but it is always difficult to determine whether these symptoms are caused by the pulmonary trouble or by a beginning intestinal infection. Increased activity in the lungs would cause fever and this in turn lead to gastric and intestinal disturbances, or these latter may themselves account for the fever. In some cases starvation of the patient for forty-eight hours will cause a disappearance of the symptoms, particularly the fever. The writer sometimes uses this test to determine whether the symptoms have their origin in the lungs or in the gastrointestinal tract.

Of the purely digestive symptoms anorexia is usually one of the first to be noted, although in rare instances the patients have enormous appetites and seem unable to satisfy their craving for food. The loss of appetite may be simply a lessened desire for food or may be caused by nausea which the presence of food produces. In other cases eating causes pain or the ingestion of food may stimulate the bowels so that a movement is imperative before the meal is finished or shortly after, and for

these reasons the patients are afraid to eat. Almost all patients have considerable flatulence and complain in greater or less degree of this. This varies from a full feeling in the abdomen to active rumbling in the intestines which may or may not be accompanied by pain, "gas pains," as they are termed. Sometimes the gas is expelled from the stomach as eructations, at others it is passed by the rectum or in other cases in both directions.

Pain varies greatly in intensity. Some patients never have any subjective pain, although tenderness can usually be found by careful palpation, while others have sharp colicky attacks which closely simulate acute appendicitis. All grades of intensity may be found between these two extremes. The pain is usually localized in the lower part of the abdomen, but is sometimes referred to the epigastrium. It usually occurs from one to three hours after eating, about the time that food reaches the ileocaecal valve. When this occurs it gives a good idea of the site of the trouble. Nausea and vomiting are of less frequent occurrence, accompanying the pain, than we find in ordinary appendicitis, but one or the other of these occurs in the majority of the patients. In a few cases vomiting is the chief symptom, and in one case an absolute inability to keep even liquids in the stomach was the only symptom found and was only explained by autopsy, which revealed extensive ulceration throughout practically the whole length of the small and large intestine, accompanied by enlargement of the mesenteric glands.

We have been accustomed to associate diarrhoea with intestinal tuberculosis and this has been considered to be the one constant symptom of this trouble, without which a diagnosis could not be made. This view is fallacious and if we wait for diarrhoea to develop we are in the position of the physician who will not make a diagnosis of pulmonary tuberculosis until he can find a cavity in the lungs. Diarrhoea is a frequent symptom but is often found only in the advanced stages and it is not infrequent to find constipation of an obstinate variety as a troublesome symptom. The looseness of the bowels is probably caused by the contents of the intestines setting up an irritation of the ulcerated areas which in turn causes increased peristalsis. The constipation, on the other hand, is probably the result of spasm of the intestines caused by this same irritation or in some cases there may be a partial obstruction from hypertrophic tissue or adhesions. All degrees of looseness of the bowels may occur from one soft nonformed stool a day to many watery movements which drain the patient's system and speedily wear

him out. As mentioned above, ingestion of food in some cases excites peristalsis so that a movement is imperative before a meal is finished. Sometimes diarrhoea is only relative and, on being questioned, a patient will admit that while he was previously constipated, only obtaining movements with the aid of laxatives, he now has a daily stool without artificial assistance. A curious fact has been brought out by the X-ray examination of the intestines and this is that some patients, who have complained of constipation, may completely empty the intestines of the barium in twenty-four hours, showing an actual hypermotility instead of delayed activity. In a few cases the beginning of the diarrhoea may be definitely dated from an acute intestinal disorder, as in the case of a returned soldier whose trouble began after eating some tinned food in France, after which there was an epidemic of diarrhoea in the battery to which he was attached.

It must be recognized that all these symptoms may come in waves for a time, periods of quiescence and periods of activity alternating, although when the disease is once well established the symptoms usually become progressively worse. Examination of the abdomen usually reveals some tenderness on palpation. This is frequently localized and is constantly present for a long period of time so that it may be found on repeated examinations. The right lower quadrant, corresponding to the most frequent pathological location of the ulcers in the lower ileum and caecum, will usually be found to be the site of tenderness. Often pressure will cause the pain to radiate across to the opposite side of the abdomen or to the epigastrium, and at times pressure over the tender area will produce a feeling of nausea. In some cases it is possible to palpate a mass in the diseased area which represents either thickening of the bowel wall, usually the caecum or ascending colon, or else a massing together of coils of intestine by adhesions. Those cases which tend to assume a more chronic course will show the greatest evidence of thickening, as hyperplasia must be looked on as a reaction on the part of the intestine against the infection, and these cases are the most favorable for operation. The more acute cases, in which the ulceration is widespread, rarely give any palpable evidences of thickening. When pain is a prominent symptom there will be a sensation of resistance over the diseased bowel, which at times amounts to an actual rigidity of the abdominal muscles.

Formerly much importance was placed on an examination of the stools in the diagnosis of intestinal tuberculosis but we now recognize that this

is of little importance. Mucus, pus, and blood cells, and tubercle bacilli may all be found but are not diagnostic as it is the rule for patients with pulmonary tuberculosis to swallow some of their sputum involuntarily, as during sleep, and this swallowed sputum will cause the appearance of mucus, pus and bacilli in the faeces, while the ingestion of meats will make the faeces give the chemical reactions for blood. The recognition of this will make it clear why we cannot place much reliance on the examination of the stools in diagnosis. The gross appearance of the stools varies greatly from a hard, constipated, formed mass to a thin watery evacuation. The latter type of stool is usually found only in the advanced cases, although occasionally it occurs in the cases with more localized disease. Frequently the defecation is more properly termed soft or mushy and this may be looked on as the most typical form in the earlier cases. Blood is not often seen in macroscopic quantities, although haemorrhage from the intestines occasionally occurs. Mucus may be seen in quite large masses. The odor is usually foul and when once noticed is quite characteristic, so much so that the patients themselves often speak of it. An examination of the blood often shows some degree of anaemia and there is frequently a noticeable leucocytosis, the increase affecting all forms of cells. This may be caused by a diminution in the fluid content of the blood from the diarrhoea or may be due to absorption through the ulcerated areas of septic or putrefactive materials.

Probably the greatest help in the diagnosis of early intestinal tuberculosis is an X-ray examination of a barium meal, the details of which are exhaustively given in a recently published paper by Brown and Sampson (1). The examination must always be controlled by a knowledge of the findings in the normal case. In these the barium will reach the ileocaecal valve in from one to three hours after ingestion. The caecum should be seen in from two to five hours, and in from six to eight hours the head of the column should have reached the hepatic or splenic flexure. The caecum should remain filled, partially at least, for twenty-four to thirty-six hours. Complete evacuation of the barium from the bowel takes from thirty-six to forty-eight hours. When the caecum and large bowel, at least the first half, are filled with barium, the outline of the shadow is even and regular except at the indentations of the haustral sacculations. Where ulceration is present one of the most striking facts noted is a hypermotility of the intestines, or increased rapidity of the progress of the barium. Apparently when this reaches

the ulcerated surfaces, peristalsis is set up by the irritation and the contents rushed along more rapidly than normally, so that in six to eight hours the head of the column is much lower down than in the normal case. Frequently the rectum is found filled with barium in six hours, and in twenty-four hours the barium has been completely expelled from the intestines or at most a small residue remains in the rectum. In other cases a different picture is seen and instead of the head of the column being too far advanced, in six to eight hours the barium is held up at the ileocaecal valve so that none has entered the caecum at this time. The explanation of this is probably a spastic closure of the valve caused by the irritation of the mass on the ulcers, or partial obstruction from thickening of the intestinal walls, or from adhesions. Following up these cases, however, reveals the fact that once this spasm is overcome and the barium enters the caecum, it is then hurried on; and in twenty-four hours we have the picture described above, namely, an empty intestine. This picture is known as "ileal stasis."

The other divergence from the normal is that of defective filling of the diseased part. Instead of the evenly filled caecum and colon with sharp, clear-cut outline and normal haustral markings, the ulcerated area presents an irregular outline with somewhat fuzzy edges and narrowing of the diameter of the shadow.

These three pictures, hypermotility, ileal stasis, and filling defects, make up what we consider a triad of appearances which are indicative of ulceration of the caecum and ascending colon. There is usually a combination of these but anyone alone is suggestive. Up to the present it has been impossible to find any picture diagnostic of disease in the small intestine. In some cases barium enemata have been given and the progress watched under the fluoroscope and then plated. These have seemed to be less satisfactory than the ingested meal, but in some cases have given valuable information, particularly as to the location and extent of the lesion. Normally the enema passes backward through the sigmoid, descending, transverse, and ascending colon, filling these and the caecum evenly and being arrested at the ileocaecal valve. When diseased, the colon does not fill so evenly, sometimes pain is marked when endeavoring to fill the caecum, and frequently the ileocaecal valve permits the barium to enter the small intestine.

As to the value of the X-ray examination in the diagnosis of these conditions, no one who has had experience with it can doubt; and it is at least of as much help as is the X-ray examination of pulmonary cases.

It is necessary, however, that the plates be interpreted by a person who has had experience if information of value is to be obtained; and the necessity of correct interpretation cannot be too strongly insisted on. In those cases of my own which have been X-rayed and later operated on, only once has the X-ray failed to distinguish between tuberculous ulceration and other conditions and in that case the condition was one of localized ulceration around the orifice of the appendix in which three different tests failed to show what we consider a typical picture of tuberculosis.

The course of this disease is usually progressive unless something is done to arrest its development. This makes the prognosis distinctly serious, but even here we are learning that there are grounds for hope in some few cases. A few years ago, and even now, the statement that some of these cases become arrested or heal spontaneously would have been hotly denied by many physicians, but I have no hesitation from my own experience in saying that this is not only possible but does occur in a limited number of patients. If the X-rays give a correct interpretation of this condition, and as far as we have gone this is a justifiable conclusion, then we must admit that some patients who have had intestinal symptoms and who have given positive X-ray pictures, have lost the symptoms temporarily at least, and later X-rays have failed to show evidences of any disease. Even stronger evidence than this is the fact that in five patients in whom operation revealed tuberculosis which for one reason or another could not be removed, the disease is now apparently arrested. The length of time since operation in these cases is from five and one-half years to one year. Three of them, operated on respectively five and one-half years, two years, and one year and nine months ago, are back at work, while the other two are still undergoing treatment but improving, two years and four months and one year after operation.

Having made the diagnosis of tuberculosis of the intestines can anything be done to help nature to arrest the condition? One difficulty in the way of healing of these intestinal ulcers has been the nearly constant movement of the intestines, and our inability to give them physiological and mechanical rest such as is essential for healing. The benefit of the rest treatment during active disease is well known in pulmonary, laryngeal and joint cases, and if we could get a similar rest for the intestines, we could expect more frequent healing. Medical treatment can do much to give relief of symptoms and by giving relief put the

bowels in the best possible condition for healing. Theoretically it would be expected that regulation of the diet should have a beneficial effect and a nonirritating diet without much indigestible residue, which is not liable to fermentation and which is constipating rather than laxative, would be indicated. Unfortunately in practice it is not found that diet has much effect on the symptoms; and we are confronted by the problem whether to cut down the diet in the hope of giving relief to symptoms and thus running the risk of weakening the patient or allowing a fuller diet to keep up strength and disregard its effect on symptoms. Each case must be considered by itself and various diets tried out, eliminating the ingestion of such substances as are found to aggravate the symptoms for that particular patient. It must be remembered that it is better to have a small quantity of food digested and assimilated than to force the patient to eat and have much of the food passed in an undigested state. In other words, it is the amount of food assimilated that counts, and not the amount ingested.

Medicinal treatment has been tried faithfully and while the symptoms may be relieved there is no drug which we know that has a curative effect. Relief of symptoms, however, not only makes the patient more comfortable but does eliminate irritation to a certain extent and thus favors healing. Intestinal antiseptics have never given much benefit. Salol, creosote, iodoform, beta-naphthol and others have been tried. Iodine has apparently given relief in some cases. This lessens the flatulence and consequent gas pains, and in this way seems to quiet peristalsis. While I do not think that the iodine directly aids in healing, I have had noticeably good results symptomatically. Of the drugs which are given to check the diarrhoea, bismuth and its salts, iron, lead, tannic acid and its organic derivatives, gallic acid, aromatic sulphuric acid and others have all been tried. Usually opium has to be resorted to, both for the pain and for the diarrhoea. For this, opium itself as the powder, tincture or as paregoric has a better effect than the alkaloids, morphine, codeine and so forth. Calcium salts, particularly the chloride, were formerly much used to check diarrhoea, but owing to their nauseating properties fell into disuse. Recently calcium chloride used intravenously has been advocated, 2 to 5 cc. of a 10 per cent sterilized solution being injected into one of the arm veins every few days. Personally I have not been able to obtain more than very transient results from this. Calcium carbonate in large doses has in a few cases given better results and is much less irritating. Recently I have been

using mineral oil in these cases in the hope that the food would be passed along with less irritation to the ulcerated surfaces and at times, while the movements have at first increased in frequency, their number has later diminished and there has been less flatulence and pain. Lavage of the colon has been advocated; but its results are disappointing and the lavage is frequently accompanied by considerable pain and faintness. Heliotherapy has been recommended, either by exposure to the direct rays of the sun or to the artificial light of the quartz lamp. My experience with this has been limited and the results not encouraging, but the method is worthy of trial if it can be thoroughly carried out, which is difficult without special arrangements.

Within the last few years our thoughts have turned to the possibility of treatment of some of these cases by surgery. Archibald (2), in 1917, reported 27 cases which came to operation and his numbers have since been greatly augmented. I have given a brief résumé at the end of this paper of those of my own patients who have been operated on for tuberculosis of the intestines. The surgical procedures which are possible are several. Excision of all the diseased portion is the ideal and has been possible in some instances. If the disease is well localized and limited in extent and the patient is sufficiently strong to stand this procedure, much may be expected from this. If the disease is too extensive to justify such an excision or if adhesions make this impracticable, an anastomosis of healthy bowel above the site of disease into healthy bowel below, with exclusion of the diseased area and the establishment of a fistula to permit of drainage from the ulcerated bowel, will sometimes give such a degree of rest to the diseased portion that arrest of the process takes place. In other cases operation shows such a condition that the disease cannot be dealt with and nothing can be done. In some of those cases, in which pain has been a prominent symptom, removal of the appendix without further surgical intervention has given marked relief. In a few cases an ileostomy, above the disease, with the establishment of an artificial anus, has been done, but this is an extreme measure and the future life of the patient must be fully considered before such a procedure is justified. Ideally this might be looked on as a temporary measure with the hope that later on an anastomosis might be done, but up to the present I know of no case in which this secondary operation has been attempted. I am not competent to discuss the surgical technique of these various operations and it is my aim merely to outline the possibilities of surgery in this disease, giving the results of

operations in cases in which some attempt has been made by others to benefit my patients. While surgery offers hopes, probably greater than any other yet tried mode of treatment, and it is attractive to medical men and to the patients themselves when once explained and suggested to them, it is necessary to curb our enthusiasm and to consider the possibilities from all sides, medical and surgical.

First, we must be convinced that the operation offers hopes of relief of symptoms or of arrest or removal of the disease, and that the dangers of the operation are less than the danger of the disease for which it is recommended. In patients with pulmonary tuberculosis operative procedures are more dangerous than in others who have healthy lungs. It is true that many, in fact most of these patients, stand the operation and the anaesthetic well; but in some cases, no matter how carefully and skilfully surgeon and anaesthetist do their parts, the lung trouble is made distinctly worse, sometimes acutely so, and this activation of the lungs initiates a progressively downward course. The condition of the lungs is all important in the decision for or against operation and no matter how localized the intestinal disease, if the lungs show evidences of progressive trouble, the operation will be a danger or at least will have no effect in the ultimate results. The prognosis may be said to depend more on the lungs than on the intestines. If the lungs seem to be stationary or inactive and the patient's symptoms to be chiefly caused by the intestinal disease, then operation is justifiable as a continued derangement of the digestion and consequent impossibility of obtaining proper nutrition will, in all likelihood, later on favor a spread of the trouble in the lungs. Another point to be recognized is that no matter how recent the intestinal symptoms, and how localized the intestinal disease seems to be, by our present methods of examination it is impossible to definitely predict the extent of the intestinal ulceration. This has been demonstrated time and again at operation and many disappointments have been met with when the extent of ulceration is seen in supposedly localized cases. These operations must for this reason be considered as more or less exploratory and this should always be explained beforehand to patient or friends. Until our knowledge is more complete and our experience, particularly in the selection of suitable cases, is longer and greater we must look on operation as a two-edged sword, capable of great benefits on the one hand, but on the other of doing harm. Whether the sword cuts in one way or in the other depends largely on the physician who recommends its use and on the surgeon who wields it.

SUMMARY

1. Intestinal tuberculosis may and does occur as a complication in all stages of pulmonary tuberculosis, incipient as well as advanced.

2. The commonly described symptoms are those of advanced disease and the symptoms of early intestinal ulceration are usually slight and indefinite.

3. Early diagnosis is possible in many cases and has been particularly aided by the use of X-ray examinations.

4. Spontaneous recovery has been known to occur in a few cases.

5. Surgery offers the greatest hope in treatment but the cases for operation must be carefully selected.

6. The condition of the lungs is as important as the condition of the intestines in deciding for or against operation and in prognosis.

7. We have as yet no means of accurately estimating the extent of intestinal disease, and for this reason operation must always be more or less exploratory.

REFERENCES

(1) Brown, L., and Sampson, H. L.: The early roentgen diagnosis of ulcerative tuberculous colitis. Amer. Rev. Tuberc., 1920, 698.

(2) Archibald, E.: Nat. Assoc. Study and Prev. Tuberc. Tr., 1917, 117.

CASE REPORTS

No. 349. Miss S. S., twenty-seven years. Operated on in 1911, for tuberculosis of caecum and lower ileum. Resection of diseased bowel. In 1916 symptoms of pulmonary tuberculosis and lesion found at right apex. This became arrested after a few months' treatment. In 1917 some abdominal symptoms suggestive of recurrence of the former trouble. There have been several attacks of pain which were apparently due to a partial obstruction. In January, 1918, the abdomen was again opened. No signs of recent tuberculosis found but many dense adhesions around the site of the former operation. After thorough examination the abdomen was closed. Patient had been in good health since.

No. 129. J. A. M., male, twenty-five years. In 1910, pleurisy with effusion and pulmonary tuberculosis at both apices. Treated for this for eighteen months when he went to Western Canada for a little more than a year, returning East in July, 1913, with all symptoms and signs increased. In June, 1912, digestive symptoms were noticed, distress after eating, flatulence, no nausea or vomiting, rise in temperature to 103° associated with abdominal attacks. Bowels have been loose, movements being soft, but not watery, and odor very foul. Examination in July, 1913, revealed tenderness in right lower quadrant and thickening around the caecum. Operation, August 15, 1913, revealed tuberculosis of caecum and ascending colon, which were excised and an anastomosis made between ileum and transverse colon. The abdominal symptoms were improved temporarily but later returned. Death occurred May 22, 1914. A few days before death a fecal fistula developed in the right lumbar region.

No. 316. A. P., male, thirty years. In spring of 1914 developed symptoms of pulmonary tuberculosis with signs at the right apex from which a good recovery was made. In December, 1914, had some fever and symptoms of indefinite character, referable to the digestive tract, with some tenderness in lower abdomen and a palpable mass in ileocaecal region. Constipation was an obstinate symptom. Operation, February 10, 1915, revealed free fluid in the peritoneum. Ileocaecal and mesenteric glands enlarged. Peyer's patches enlarged, with subperitoneal tubercles and plastic lymph on peritoneum underlying, thickening of whole of large intestine down to sigmoid. Appendix thickened with a constriction near the base. The appendix was removed and an anastomosis made between the ileum about 5 inches above the ileocaecal valve and the sigmoid. Convalescence was stormy, the abdominal wound broke down and healed slowly by granulation, the lung disease became active and spread, an ischiorectal abscess developed, and there was severe diarrhoea. In August, 1915, an acute intestinal obstruction developed, due probably to regurgitation of feces into descending colon where inspissation took place. This was eventually relieved by an enema of milk and molasses. After this recovery was steady but slow. Patient resumed his work in autumn of 1917, since which time he has had no symptoms, either pulmonary or intestinal.

No. 471. Miss S. N., forty-one years. Pulmonary tuberculosis diagnosed in spring of 1916. Moderately advanced. During summer of 1917 digestive symptoms, chiefly pain and diarrhoea, developed. Operation was advised and performed in December, 1917. Extensive tuberculosis of the ileum and large bowel and appendix was found so that nothing more than an appendicectomy was done. This resulted in relief from pain, the other symptoms remaining as before operation. In March, 1919, there was a small haemorrhage from the bowels. Since the autumn of 1919 there has been a marked improvement in all symptoms. The diarrhoea has stopped, appetite improved, flatulence lessened, weight increased fifteen pounds, and the temperature rarely rises above 99°, whereas previously it was from 100° to 102° daily.

No. 516. G. F. C., male, thirty-three years. Pulmonary tuberculosis discovered in July, 1917, confined to the right upper lobe. Patient did not seem to improve and in the autumn digestive disturbances were noted. These consisted of pain, dull in character, about one and a half hours after eating, anorexia, flatulence, marked constipation, no nausea or vomiting. There was tenderness in the caecal region and a movable mass was felt. Roentgenograms of a barium meal gave positive evidences of caecal tuberculosis and operation was advised, as it was felt that the evidences pointed to localized trouble. Operation, January 3, 1918, revealed extensive ulceration in small and large bowel and appendix. The appendix was removed. The course of the disease was steadily progressive after the operation, both in the lungs and intestines. In March, 1918, a right sided pleurisy with effusion developed, and in May the patient returned to his home and no further information has been obtained.

No. 657. E. S., male, thirty-six years. In July, 1917, symptoms of pulmonary tuberculosis developed but increased and were accompanied by looseness of the bowels early in 1918. At this time there was far advanced disease in the left lung and some signs at the right apex. Anorexia, flatulence and diarrhoea were present. There was marked localized tenderness over the caecum and ascending colon. X-ray examination of the intestinal tract showed tuberculosis of the large bowel and operation was decided on owing to the miserable condition of the patient. This was performed in May, 1918, and revealed extensive tuberculosis of the large intestine and to a less extent of the small intestine. Nothing was attempted. The patient rallied from the operation but a few days later sank rapidly and died.

No. 679. W. A. S., male, twenty-six years, 1918. Disease in the chest was suspected three years previously, but not until examined for the draft was a definite diagnosis made. In April, 1918, after being under observation for a month, it was found that the general condition was not improved, temperature between 99° and 100° was constant, digestive symptoms were marked but the signs and symptoms referable to the lungs were lessening. Examination of the abdomen showed definite movable thickening of the caecum, and X-ray examination was positive for tuberculosis of the caecum and ascending colon. Operation showed a tuberculous condition of the ascending colon; and this was removed together with three or four inches of the ileum and the small piece of the transverse colon. The after course of this case has been interesting. The patient had several pulmonary haemorrhages in October and November, and in December artificial pneumothorax was induced on the right side. This has been carried out ever since and the subsequent course of the case has been satisfactory, and patient is now free from abdominal symptoms and doing light work in New Mexico.

No. 681. W. S., male, forty-four years, 1918. Moderately advanced pulmonary tuberculosis involving the upper part of both lungs. In the spring of 1918, had pain in the abdomen with rise in temperature, and symptoms of acute appendicitis. Diagnosis at this time was appendicitis or caecal tuberculosis. Patient went to his home for operation and the appendix was removed, but caecum was found badly inflamed and thickened, adherent to surrounding structures and abdominal wall, and covered with minute tubercles. This was not touched. The wound broke down and healed slowly by granulation, but the patient improved slowly. In May, 1919, X-ray examination showed changes in the region of the caecum and ascending colon. In spite of these positive findings there are no digestive symptoms and patient has returned to his work.

No. 802. Miss M. N., twenty-four years, 1918. Pulmonary tuberculosis of both apices, history of looseness of the bowels, movements occurring immediately after eating, gas and crampy pains with occasional nausea lasting for several months. Abdominal examination showed thickening in the region of the caecum and slight tenderness. X-rays were positive for caecal tuberculosis. Operation in September showed the appendix to be studded with tubercles, ulceration and thickening of the caecum and lower end of the ileum. The lower six inches of the ileum and half of the ascending colon were removed. Convalescence was uneventful and patient has been back at her work for the past year.

No. 504. Miss G. M., thirty-five years, 1917. Had had symptoms and signs of early pulmonary tuberculosis for six months when coming under observation. Returned to her work in autumn of 1917, and was quite well with the exception of three attacks of so called appendicitis during the winter of 1918. In July, 1918, was operated on for appendicitis; but extensive tuberculosis of the lower eight feet of the ileum and matting together of the caecum and ileum, with involvement of the caecum, was found. Nothing could be done and the abdomen was closed. Patient was lost sight of for twelve months; then came back, reporting that she had been working steadily, feeling well with the exception of four weeks in the autumn of 1918, when she had influenza and bronchopneumonia. She has had no abdominal symptoms whatever, signs in her lungs have increased slightly, but after a short rest she returned to her work where she is continuing in good health.

No. 754. Miss F. C. R., twenty-eight years. Had pleurisy with effusion in spring of 1918, but had been coughing before this. In summer of 1918 had moderately advanced pulmonary tuberculosis of the right upper lobe and left apex. In August had severe pain

in epigastrium accompanied by vomiting and fever to 102°. Examination at this time showed definite tenderness in the right lower quadrant with a mass in the region of the caecum. When the acute attack had subsided X-rays showed positive evidences of ulceration of caecum and ascending colon. Operation the end of September showed thickening of the caecal wall and ulceration of caecum and ascending colon. The appendix and the diseased portion of the ascending colon were removed. For a time after the operation symptoms were relieved, but gradually returned, and death took place ten weeks later. Partial examination showed that there was a peritonitis with gas and feces in the peritoneum, the anastomosis between the ileum and colon having given away at the base of an ulcer found at this point. There was also further ulceration in the transverse colon.

No. 783. J. B., twenty-two years. In July, 1918, came under observation for pulmonary tuberculosis, moderately advanced, upper three-quarters of left lung and apex of right. In May, while in France, had an attack of acute diarrhoea following eating of some tinned food which caused an epidemic of this trouble in the battery to which patient was attached. This looseness has continued with two or four stools a day, soft but not watery, considerable flatulence, occasional pain felt with gas rumbling. Examination showed tenderness over the caecum and ascending colon. X-rays were positive but apparently showed a localized disease from the caecum to about half way across the transverse colon. Operation in September showed appendix, caecum, ascending colon, and first half of transverse colon to be diseased and thickened. This part of the intestine was removed and a lateral anastomosis between the lower end of the ileum and transverse colon was made. All symptoms improved for a couple of months, after which time there was a recurrence of looseness of the bowels and a certain amount of flatulence but no pain. Tenderness on the left side of the abdomen along the line of the descending colon. Diagnosis was made of ulceration of the transverse colon and splenic flexure, and operation was again decided upon, although the condition of the lungs was worse than previously. On April 4, 1919, operation revealed ulceration of transverse colon, descending colon, and sigmoid flexure. The lower end of the ileum was brought out of the abdominal wound and an ileostomy established. During the summer of 1919 there was improvement of symptoms; but in the autumn the temperature became higher, there was loss of weight, cough and expectoration greatly increased. The last examination made a few days ago shows the temperature to be lower, rarely above 99°, condition of the lungs improving, cough and expectoration less, digestion good, weight increasing, and examination of the discharge from the rectum failed to reveal any tubercle bacilli.

No. 876. Miss H. J., twenty-four years, July, 1918. Had been ill for two years with pulmonary tuberculosis, in bed and with fever most of the time. When coming under observation she was found to have extensive disease through the whole left lung with cavitation at the apex, and a few signs just below the clavicle on the right side. Artificial pneumothorax was induced and a partial collapse of the left lung obtained. This was followed with relief of pulmonary symptoms. At this time there was also some slight looseness of the bowels and pain and tenderness in the right lower quadrant. In October, 1918, had acute influenza, after which some râles appeared in the back of the left lung. The abdominal symptoms increased and some nausea developed, temperature began to rise and X-rays of intestinal tract showed positive evidences of caecal tuberculosis. Operation was performed on April 29, 1919, and a limited tuberculosis of caecum and ascending colon was found. Three inches of the ileum and about eight inches of the big bowel being excised, and lateral anastomosis performed. Convalescence was uneventful, but in July, 1919, dysphagia and laryngeal symptoms developed with positive signs of tuberculosis of larynx on examination. The laryngeal condition and pulmonary condition were progressive. Death took place on January 29, 1920, evidently due to the pulmonary disease and not to the intestinal.

No. 803. Miss M. A., twenty-six years, 1918. History of pulmonary symptoms for about a year, lungs showing extensive disease all through the left and at apex of the right side. No very definite improvement. In March, 1919, had an acute attack of abdominal pain which persisted in a lesser degree. Some fever accompanied this and examination showed very marked tenderness in the right lower quadrant, with some thickening probably of the caecum. As the symptoms continued, operation was decided on in spite of the advanced lung condition, and was carried out May 5, 1919. Tuberculosis of the caecum, and ascending colon, and lower end of the ileum were found. Six inches of the ileum and the ascending colon as far as the hepatic flexure were removed. There were never any evidences of improvement after this operation and the lung symptoms as well as the intestinal symptoms have become progressively worse, accompanied by high fever, loss of weight, night sweats and chills. Patient has been removed to her home, but is still living, now nearly a year after the operation.

No. 971. Miss M. T., twenty-two years, 1919. Far advanced pulmonary tuberculosis on the left side with symptoms dating back about a year. A couple of months after coming under observation symptoms of gastrointestinal disturbances, especially persistent vomiting occurring about two hours after meals, with pain in the lower part of the abdomen and tenderness in the lower quadrant, and high temperature developed. These symptoms all increased so that the patient's life was a burden and operation was requested. Extensive tuberculosis of the large intestine was found; appendix was removed and an ileostomy performed. The operation was followed by rapid breakdown of the lung and development of a large cavity below the left clavicle, accompanied by expectoration of large quantities of foul smelling purulent material. Death occurred about two weeks later.

No. 945. Mrs. G. E. D., twenty-eight years, March 21, 1919. History of pulmonary symptoms with pleurisy off and on for four years. Examination shows moderately advanced disease of the left lung. Gastrointestinal symptoms, diarrhoea, pain, flatulence, tenderness in region of the caecum were present when first coming under observation, and became more marked, the pain being quite severe from time to time and accompanied by vomiting during the attacks. Barium meal was positive for tuberculosis of the large bowel, and operation was decided on and performed July, 1919. This revealed ulceration of the lower end of the ileum and one or two areas of thickening in the caecum, and also in the transverse colon. The ileum from above the ulcerated area was planted in the sigmoid and the appendix was removed. Recovery was uneventful and at last report patient was doing well in spite of a temporary setback caused by the death of her only child. Artificial pneumothorax was attempted but was unsuccessful.

No. 784. Miss W. B., twenty years, July 31, 1918. History of short illness with looseness of the bowels from start. Examination showed moderately advanced disease through the upper three-quarters of the right lung, with left lung uninvolved. Artificial pneumothorax was performed in November with good collapse of the lung and lessening of symptoms. Looseness of the bowels continued with anorexia and some flatulence and pain in lower abdomen. X-ray examination was quite negative. This examination was repeated four months later and was likewise negative. Patient went to her home in the summer of 1919, returning in August, at which time the abdominal symptoms were decidedly increased and some fever was present, between 99° and 100° each day. Laryngeal tuberculosis had developed and artificial pneumothorax was not successfully continued while at home, so that now there is only a small cavity which was later gradually distended and a fair collapse again obtained. Intestinal symptoms are a watery movement in the morning and a soft

movement three or four times a day besides this. Foul odor to the stools, considerable flatulence, nausea most of the time. Operation was decided on and performed September 5, 1919. Before this another X-ray was taken and this was also negative for tuberculosis. The operation revealed one definite ulcer high up in the jejunum and a ring of ulcers around the opening of the appendix into the caecum. The appendix was enlarged and thickened. Some glands in the mesoappendix were enlarged. The appendix and a circular piece of the caecum including the ulcerated area was removed. Abdominal symptoms have completely disappeared, but patient is still under treatment for the pulmonary and laryngeal condition.

No. 338. Dr. H., forty years, October 30, 1915. Had been ill for about a year with pulmonary tuberculosis and some digestive symptoms. These consisted of looseness of the bowels with occasional attacks of pain and nausea, at which time temperature was elevated, considerable flatulence. Examination showed marked tenderness in right lower quadrant with distended movable mass. Per rectum this same mass may be felt on the right side. Although the patient's condition was not favorable he requested operation, which revealed tuberculosis of the ascending and transverse colon. Appendicostomy was done but death occurred a few days later from suppression of urine.

No. 1012. Miss G. K., twenty-three years, June 10, 1919. Influenza, October, 1918, symptoms of pulmonary tuberculosis dating from this time. Examination of abdomen shows pain in right lower quadrant, some distention, some resistance on the right side, possibly a little thickening of the caecum; bowels are a little loose, especially immediately after eating, appetite poor, some flatulence. X-ray examination of barium meal showed positive evidences of tuberculous ulceration. As patient failed to improve under regular treatment operation was performed the first of October. Extensive tuberculosis all through the small and large bowel and appendix was found. The appendix was removed but patient declined steadily and rapidly, dying on the 30th of November, 1919.

No. 1003. Miss K. S., thirty years, May 28, 1919. Indefinite history of pulmonary symptoms for a year. Moderately advanced pulmonary tuberculosis of right lung. Considerable abdominal pain coming on after meals, no nausea or vomiting, bowels rather constipated, flatulence. Later on bowels became loose and X-ray of a barium meal was positive for tuberculosis in the large intestine. As pains were becoming more severe and temperature gradually rising, everything pointing to the fact that symptoms were more due to the abdominal condition than to the lungs, operation was performed November 13, 1919. This revealed extensive tuberculosis of caecum, ascending and transverse colon, the small intestine being free. Anastomosis between ileum and sigmoid was performed and the appendix removed. There has not been any improvement following the operation and patient still has high fever, night sweats, and general symptoms of advanced tuberculosis.

No. 1119. Mrs. E. W., twenty-nine years, October 16, 1919. Complains of stomach trouble for three years, cramps felt in epigastrium, nausea and vomiting. These attacks would last about twenty-four hours. Patient run down and losing weight recently. Examination showed early disease in the upper part of the right lung. Examination of the abdomen showed marked tenderness in the region of the caecum, no thickening determined. X-rays were positive for caecal tuberculosis. Operation was performed November 24, 1919, and revealed chronic appendicitis and thickening of the walls of the caecum. The appendix was removed but caecum was left. On returning after the operation there was an increase in all the abdominal symptoms and also in the pulmonary symptoms, and an extension of pulmonary disease. The disease, both the abdominal and pulmonary, has been progressive since.

No. 1173. Mrs. M. N., thirty years, December 15, 1919. Moderately advanced disease of the whole of the left lung. Has been run down for about six months, there has been some looseness of the bowels and abdominal cramps for past week, before which time no digestive disturbances were noted. Examination showed very marked tenderness in right lower quadrant but nothing beyond this. X-rays positive for intestinal tuberculosis. As the pains were increasing and becoming more frequent and digestive disturbance more marked operation was decided on and performed February 24, 1920. This revealed ulceration through the greater part of the small intestine, caecum, ascending, transverse, and descending colon down as far as the sigmoid. The appendix was removed and nothing else done. Since the operation there has been no abdominal pain, but the looseness of the bowels and flatulence continues, temperature has been elevated each day and patient is rapidly losing strength.

Summary of cases

Total number of cases operated on	22
Total number of operations	23

Operations		*Results*	
Excision	9	Alive and well	3
		Alive—improved	2
		Alive—unimproved	1
		Dead	3
			9
Simple laparotomy	2	Alive and well	1
		Dead	1
			2
Ileosigmoidostomy and appendicectomy,	3	Alive and well	1
		Alive—improved	1
		Alive—unimproved	1
			3
Appendicectomy	6	Alive and well	1
		Alive—improved	1
		Alive—unimproved	2
		Dead	2
			6
Appendicostomy	1	Dead	1
			1
Ileostomy	2	Alive—improved	1
		Dead	1
			2

Total cases 22

		Per cent
Alive and well	6	27.2
Alive—improved	4	18.2
Alive—unimproved	4	18.2
Dead	8	36.4
	22	100.0

Cases in which death was hastened by operation 3

In conclusion I wish to thank Drs. Archibald and Bazin of Montreal, Dr. R. M. Brown of Saranac Lake and Dr. Lothrop of Buffalo, and other surgeons for their operative treatment of these cases, and also Mr. H. L. Sampson for his painstaking and skilful X-ray diagnoses.

THE OCCURRENCE OF INTESTINAL TUBERCULOSIS IN PATIENTS WITH PULMONARY TUBERCULOSIS AT THE TRUDEAU SANATORIUM

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A recent study of intestinal tuberculosis by two of us has led us to believe that it can now be diagnosed in many instances long before symptoms, formerly considered characteristic of it, appear. With such a method at our disposal we began a study to see when it first appeared in the course of pulmonary tuberculosis. It was but natural that a routine examination of all patients admitted to the Trudeau Sanatorium should be undertaken by this roentgenologic method and we wish now to report on 89 unselected consecutive cases. At the same time we submitted 80 of them to a carmine test to see if it would reveal hypermotility if present.

BARIUM MEAL TECHNIQUE

The barium meal technique differs slightly from the one mentioned in a previous communication (1) in that the patients are examined more frequently. The examination was mainly roentgenoscopic. However, plates were made at frequent intervals in many cases, in order to check or clarify doubtful observations. For the thirty-six hours prior to the ingestion of the barium meal, usually given at 9 a.m., the patient abstained from the use of any laxative. Breakfast was permitted. The ingestion of the barium meal was observed reontgenoscopically. Following the ingestion, examinations were made at two hour intervals for the next ten hours or oftener if the case warranted it. Dinner was omitted. The patient was then examined every twenty-four hours until there was a complete elimination of the barium. In some cases of marked constipation the patient took a laxative after the seventy-second hour examination. This was done to give him relief.

RESULTS OF BARIUM MEAL STUDY

Immediately following the ingestion of the barium meal nothing of importance was observed in any of the cases. The different types of the stomachs varied from hypertonic to atonic and the position (height) was also a very variable factor. In some of the cases extreme ptosis was observed. The cap or first portion of the duodenum was seen at this examination or the next in practically all the cases.

The second hour and fourth hour examinations revealed the usual or "normal" picture. However, the latter possibly threw a little light on the question of tuberculous enteritis, whereas in many of the cases previously recorded (1) we had observed marked segmentation of the ileum with apparently localized stasis and dilatation. This was rarely observed in the present series of routine cases. These manifestations, it would seem, deserve further and closer study.

In 11 cases (12 per cent) a gastric retention was observed at the eighth hour. From observations previously made (1) the impression was formed that gastric retention occurred more frequently in patients suffering from proved intestinal tuberculosis than in those apparently negative. However, the manifestations should not be given too much weight in the present series, as only 4 or probably 6 cases were diagnosed as positive.

Considerable time and effort were spent on the examinations from the sixth to the ninth hour with more frequent observations in the suspicious cases, for during this period the roentgenological interpretation of tuberculous colitis can practically always be made. However, other factors contributed materially to the final diagnosis. In 83 cases (93.25 per cent) no definite filling defects were observed in the proximal half of the colon if enough barium had reached these sites to overfill them. The colon was usually well rounded and decided haustration was commonly seen in a large number. Attempts were made to test the excitability of the caecum and ascending colon by trying to cause this portion of the bowel to eliminate the barium it contained. This was done by moderately deep palpation. The attempt, however, was unsuccessful. It may be recalled here that the opposite is true in a majority of cases suffering from tuberculous colitis, that is, slight stimulation by palpation causes emptying of the caecum. Complete elimination of barium occurred in the negative cases at varying times between twenty-four and one hundred and twenty hours. However, two cases did reveal a

barium-free bowel at the twenty-four hour examination. The great majority eliminated the barium completely between the forty-eighth and seventy-second hour.

Four of the remaining 6 cases presented an entirely different picture—either absence of the caecal or ascending colon shadow at that time (sixth to eighth hour) when more than enough barium to fill these sites had passed, or decidedly defective filling of these parts occurred with considerable barium beyond this point. In two or three of these positive cases barium could be seen in the terminal ileum at the sixth hour examination while one-half an hour to an hour later it was apparently in the transverse and descending colon, indicating a probable site of irritability in the ascending colon. In these 4 cases complete elimination of barium occurred in twenty-four hours. The 2 remaining doubtfully positive cases presented manifestations somewhat similar to the positive cases but not characteristic enough to warrant their inclusion in the positive group. Further examination is always indicated in this type of case.

In the previous study we were impressed by the rapid complete elimination of barium from the colon, which very commonly occurred in less than twenty-four hours; and, hoping that the ingestion of carmine would throw further light on the question of hypermotility in tuberculous colitis, we started to examine routinely 100 cases at the Trudeau Sanatorium.

CARMINE TEST TECHNIQUE

To determine the motility of the gastrointestinal tract, eight hours following the last defecation the patient was given two carmine capsules (5 grains each) following which he noted the appearance and disappearance of the carmine in the stools. No modifications were made in the patients' daily routine other than that they were to abstain from the use of any laxative.

RESULTS OF CARMINE TEST

In 50 cases (62.5 per cent) the carmine appeared in the stools between the eleventh and eighteenth hours, occurring most frequently at the sixteenth hour (16 cases). The time of appearance of the 30 remaining cases varied between eight and sixty-four hours. The time of disappearance varied between twelve and one hundred and thirty-five hours,

complete elimination occurring in 34 of the cases (42.5 per cent) between the thirty-fifth and forty-ninth hour. In 5 cases the carmine was recorded as having disappeared in less than twenty-four hours. Of these only 2 were diagnosed as having tuberculous colitis. As far as the "time of appearance" is concerned no important features were brought out.

It would appear from the above data that the time of appearance of the carmine which occurred in 50 of the cases (62.5 per cent) between the eleventh and eighteenth hours was the result of taking the carmine at a specified time, namely eight hours after the last defecation, whereas the time of disappearance was not so well controlled.

SUMMARY

In this series of 89 consecutive routine examinations, tuberculous colitis was diagnosed as positive in 4 and as doubtfully positive in 2. Thirteen per cent of the patients at the Trudeau Sanatorium are discharged unimproved.

The use of carmine is of no help in determining the presence of hypermotility in tuberculous colitis.

REFERENCE

(1) Brown L., and Sampson, H. L.: The early roentgen diagnosis of ulcerative tuberculous colitis. Amer. Rev. Tuberc., 1920, iii, 698, and J. A. M. A., 1919, lxxiii, 77.

FUNCTIONAL CARDIOVASCULAR DISTURBANCES IN TUBERCULOSIS

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Vasomotor disturbances and other circulatory disorders are very common in the tuberculous. In fact, as is well known, they may be among the leading symptoms ushering in the disease. During its course they play a prominent part in the symptom complex, and even a quiescent case may still have all sorts of complaints referred to the circulatory system. In this discussion I shall pass over such cardiovascular disorders as are associated with displacement of the heart, due to the drawing of the mediastinum to the side of the advanced lesion, a condition which may cause precordial pain, dyspnea, and palpitation; as well as the dyspnea and cyanosis due to the loss of a good deal of lung tissue. I wish to consider, rather, such symptoms as precordial pain, palpitation, flushing, vertigo, fainting, tachycardia, and acrocyanosis, which occur without apparent organic basis.

These symptoms are seen, not infrequently, early in a case of tuberculosis, and some or all of them are often seen during the later course of the disease. Indeed, they are so common, and have been thought so characteristic, that some authors have described cases of latent or occult tuberculosis, which give no manifestations beyond these autonomic and sympathetic disturbances. The most recent exposition of this view is by Sewall (1), who describes patients with labile vasomotor systems as well as with symptoms of neurasthenia. In these individuals, physical and X-ray examination may reveal slight sclerosis of the hilum lymph nodes and upper bronchial radiations, and, a condition which he considers characteristic, an abnormal lowering of the pulse pressure on changing from the supine to the erect posture. These symptoms, Sewall claims, are due to a "subtle intoxication" by the Koch bacillus; they are nonprogressive, and most of the subjects of this toxemia never develop clinical tuberculosis. Head (2) has arrived at similar conclusions. He states that all patients with neurasthenia of undiscoverable etiology, who give a positive tuberculin reaction, have concealed tuberculosis.

In addition to the symptoms enumerated by Sewall, he includes the functional gastrointestinal disturbances in his clinical picture. The duration of the symptoms may be years, some even dating from childhood. Several European authors have expressed parallel opinions. Thus Papillon (3) believes that all neurasthenics should be considered tuberculous until proved otherwise, and Engel (4) emphasizes that neurasthenia is very often caused by tuberculosis, and that when it occurs in a tuberculous subject it is a toxic manifestation.

These views are undoubtedly too extreme. When we consider that the vast majority of adults harbor tubercles within their bodies without suffering from tuberculosis, that the seat of election of such tubercles is the bronchial lymph nodes, and finally that the tuberculin reaction is not an infallible guide in the diagnosis of active tuberculosis, but that most people who harbor tubercle will react positively to this test, we see on what slender evidence these authors base their conclusions. As will be seen below, similar specious arguments may be used to prove the tuberculous nature of any disease.

On the other hand, when the group of symptoms which we are discussing appears at the same time as, or shortly before, clinical tuberculosis is diagnosed in a patient, we may endeavor to establish a causal relationship between the two. Solis-Cohen (5) has studied a series of tuberculous subjects from this aspect, and has concluded that these symptoms are the manifestations of a defense reaction of the internal secretory organs to the tuberculous poison. Deutsch and Hoffmann (6) have expressed similar views.

These vasomotor, dyspeptic and asthenic symptoms, to which for convenience I shall refer as neurasthenic, are not peculiar to tuberculosis. It is a well established fact that they are often signs of a constitutional nervous instability, which is not infrequently an hereditary trait. Several authors have emphasized that neurasthenic symptoms in tuberculosis are particularly evident in patients with such a constitutional nervous predisposition. Thus the authors just quoted state that individuals who before their illness were "autonomics" are the ones who especially have autonomic symptoms when they contract tuberculosis. Jessen (7) says that lability of temperament and similar symptoms in tuberculosis are more pronounced in individuals with a poorly organized psychic nature, and that the neuroses in tuberculosis are due to the action of the toxin on a congenitally weak nervous system. The best paper that deals with this subject is by Muralt (8). He considers all of

the vasomotor and dyspeptic phenomena that one encounters in the tuberculous, as well as the fatiguability and lack of will power, and finds that a constitutional nervous predisposition is very important in the development of all of these symptoms. He further states that phthisis may activate a latent neurasthenic tendency. In the discussion of this paper Dubois (9), too, emphasizes the importance of a constitutional neurasthenia underlying the nervous symptoms manifested by tuberculous patients.

The similarity of the symptoms under discussion to those of hyperthyroidism has been noted by many observers. Brandenstein (10) reports on the frequency of an enlarged thyroid in early tuberculosis. She found as well, 6 clear cases of Graves' disease among her series of 100. In all of the cases the symptoms of hyperthyroidism ran *pari passu* with the progress of the lung condition. Biolakur (11) finds the thyroid gland enlarged in most cases with vasomotor instability, palpitation, sweating, and mental depression, particularly in women. From his study he concludes that the symptoms of Graves' disease are often an expression of tuberculous infection, and that they may be a sign of latent tuberculous infection. Saathof (12) goes even further. He found that 44 out of 45 patients with Graves' disease had occult tuberculosis, as proved by X-ray hilum shadows, and the tuberculin reaction. He uses the same faulty reasoning as those men who seek to establish the identity of neurasthenia and tuberculosis. All of these writers emphasize the more favorable prognosis in tuberculous patients who have thyroid enlargement, as well as the fact that it is a sign found especially in early tuberculosis, rarely in advanced cases.

The similarity of the symptoms in incipient tuberculosis to those in exophthalmic goitre led Goetsch to investigate whether there is any relationship between the two. In 1918 before the New York State Medical Society (13) he described an epinephrin test which, he believed, enabled one to recognize mild cases of hyperthyroidism. In individuals with just such symptoms as are under discussion, he believes that a positive epinephrin reaction indicates that the thyroid is the cause of the disorder, and that thyroidectomy will bring relief. Pathologically he finds minute adenomas of the thyroid gland in such patients. More recently he has modified his position. He concedes that a positive test does not necessarily mean hyperthyroidism, but that the exceptions are few. However he claims that all cases of hyperthyroidism will give a positive reaction, and that a negative reaction means that there is no hyperthy-

roidism (14). In conjunction with Nicholson he employed the test in the study of tuberculosis at the Trudeau Sanatorium (18). Among 18 doubtful cases of tuberculosis they found 10 positive and 8 negative reactions; among 16 inactive cases with cardiovascular symptoms, 9 positive and 7 negative; and in 6 definitely tuberculous patients they got no positive reactions. They interpreted their results to mean that those patients who reacted positively to the test were suffering from hyperthyroidism, and that tuberculosis per se does not give a positive reaction.

The technique of the test is as follows: The patient is kept in bed for twelve hours before the test. Then a series of blood pressure determinations are made until the readings become constant. It will be found that there is usually a drop of from 10 to 15 mm. of mercury in the systolic pressure within fifteen minutes. This is probably dependent on psychic factors, and is seen in all carefully controlled blood pressure observations, whether they be made on individuals with normal tension, with hypertension, or with hypotension. At the same time the patient is asked whether he feels nervous, and a note is made of the pulse rate, of the presence or absence of tremor of the hands, of throbbing of the carotid arteries or abdominal aorta, and of the circulation in the hands. Then 0.5 cc. of a 1 to 1000 solution of epinephrin is given subcutaneously. The blood pressure and pulse are taken every two minutes for the following ten minutes, and then every five minutes for one hour. A note is made of a change in any of the symptoms just enumerated. A positive reaction is indicated by a rise in the systolic pressure of over 10 mm., frequently by a drop in the diastolic pressure, by a rise in the pulse rate, and by an increase in the tremor, as well as coldness and blueing of the hands. With this, the patient often complains of feeling restless and nervous, his breathing may become rapid and deep, and he may have headache or vertigo. All of these signs and symptoms do not appear in every positive reaction. The reaction lasts about thirty minutes and gradually subsides in the course of another hour. It cannot be simulated by the slight disturbance caused in a nervous patient by the procedure of hypodermic injection.

At the Montefiore Hospital, in the tuberculosis service of Dr. Fishberg, we have chiefly cases of advanced tuberculosis, so the character of the material available has somewhat limited my study. I tested 9 patients with active advanced tuberculosis in the manner described above, repeating the tests on most of them. Of these 9 individuals, 3 gave clear positive reactions, 2 gave mild, 2 doubtful, and 2 negative reactions. The test was performed in the morning and in the afternoon on the

same patient in some instances to ascertain whether the afternoon temperature might have some effect on the reaction. No such relationship was established; and the morning and afternoon tests corresponded, except in one case. This patient was tested four times. Once in the morning on August 20, 1919, with a normal temperature, she reacted negatively. A few days later in the afternoon, with a temperature of 101°, the result of the test was doubtful. On October 14 in the afternoon with the temperature at 101.6° the reaction was weakly positive. Finally on the afternoon of February 19, 1920, with the temperature at 101°, two weeks after a severe attack of influenzal bronchopneumonia, while she was still very weak and shaky, she gave a clear cut positive reaction.

Tables illustrating positive epinephrin reactions

TIME	BLOOD PRESSURE	PULSE	NERVOUSNESS	TREMOR	THROBBING OF ARTERIES	REMARKS
P. B. Female. Age 19. Temperature at time of test 101°						
2:35	118/65	136	0	+	0	
2:40	108/56	128	0		0	
2:45	105/66	120				
2:50	108/60	124	0	+	0	
2:51*						
2:52	110/60	120	0	+	0	
2:54	145/90	144	Palpitation	++	+	
2:56	125/74	132	Palpitation	++	++	
2:58	120/74		Slight palpitation	+++	++	
3:01	120/70	128	Slight palpitation	+++	++	
3:06	126/70	132	Slight palpitation	+++	++	
3:13	110/68	132	Slight palpitation	++	++	Respirations 36, deep
3:20	112/68	132	Slight palpitation	++	++	
3:30	112/68	144	Slight palpitation	++	++	
G. R. Female. Age 24. Temperature at time of test 99°						
9:43	106/64	116	+	+	0	
9:46	110/68	112				
9:51	104/60	112	+	+	0	
9:53*						
9:54	104/68	112	+	+	0	
9:55	125/70	120	++	+++	++	Palpitation
9:57	130/70	132	++	++++	+++	Palpitation
9:59	136/70	140	+	++++	+++	Headache
10:01	130/70	132	+	++++	+++	Headache
10:06	130/70	132	+	+++	++	Dizzy headache
10:13	120/65	112	+	++	++	Feels weak
10:24	120/65	120	+	++	+	
10:30	116/65	130	+	+	+	Feels well

* Epinephrin 1 to 1,000, 0.5 cc. subcutaneously.

There is no apparent relationship between the activity of the tuberculosis, the body habitus of the patient, or his symptomatology and a positive epinephrin reaction. Nor does the family history play any rôle. Only one of the cases reacting positively gave any clinical evidence of hyperthyroidism. This girl, with a moderately advanced phthisis, has all the earmarks of a mild Graves' disease, but gave only a weakly positive, atypical reaction.

The discussion of these results will be clarified by a consideration of the meaning of epinephrin test. Goetsch has claimed that with very few exceptions it is an indicator of a definite even though latent hyperthyroidism. The similarity of these borderline cases of supposed hyperthyroidism to cases of irritable heart, also known as effort syndrome, or neurocirculatory asthenia, is striking. In a series of such cases I performed the Goetsch test (15) and found that 28.6 per cent of the men reacted positively. A positive reaction was not associated with any evidences of hyperthyroidism; in fact there were no criteria by which one could predict whether or not any particular case would be sensitive to epinephrin or not. Wearn and Sturgis (16) studied a similar, but selected, series of cases and obtained 59 per cent of positive reactions. Their higher percentage is due, I believe, to the fact that they gave the epinephrin intramuscularly instead of subcutaneously, and because they selected their cases. Peabody (17) showed that the basal metabolism of soldiers with neurocirculatory asthenia was not raised, even when they were epinephrin sensitive. Most of the men who have studied the effort syndrome agree that the thyroid is not concerned in the etiology of the symptom complex. More recently, Wearn (19) has reported a series of positive epinephrin tests on cases that were definitely nonthyroid in nature, and whose basal metabolism was normal. What then is the cause of a positive epinephrin test? I believe that it means nothing but an increased sensitivity of the sympathetic system to epinephrin, and possibly an increased sympathetic irritability. This occurs of course in hyperthyroidism, and such patients will give a positive reaction; but on the other hand a positive reaction does not necessarily mean exophthalmic goitre. Therefore, since the test shows no such specificity as was originally claimed for it, its value in the study of these borderline cases is very limited. This becomes more evident when we review the results that I have obtained, and particularly the variation of the test in a particular case. The cases are too few of course to make a study of percentages worth while, but we find a positive reaction occurring in certain

cases of tuberculosis, while in other similar cases it is negative. There are no clinical criteria by which we can predict which case will be sensitive to epinephrin. The activity of the lesion and the nervous and cardiovascular symptomatology have no evident bearing on the reaction. These results correspond with those obtained on patients with neurocirculatory asthenia.

A further comparison of cases of tuberculosis presenting signs of vasomotor instability with the effort syndrome group is of considerable interest. There are two main types of neurocirculatory asthenia. One is in individuals with constitutional nervous instability or inferiority. The other is in patients who have suffered from an acute infectious disease. In the first group an acute infection always serves to aggravate the symptoms, and not infrequently latent symptoms are first brought to light following an acute febrile attack such as pneumonia. Chronic infections such as hookworm disease may act in the same way. A careful history of phthisical subjects will reveal in some of them mild nervous vasomotor and gastrointestinal symptoms, antedating by many years the tuberculosis. In other cases these symptoms make their very first appearance with the disease. Is it not probable then that those cases of tuberculosis which are ushered in with such striking cardiovascular symptoms really belong to the neurocirculatory asthenia group, and that in them the tuberculosis acts as the acute infection, bringing to light latent symptoms? It is striking too that the so called tuberculous habitus is encountered frequently among patients with effort syndrome. Those cases with a negative history, in whom the symptoms develop during the course of the disease, are comparable to the second type of neurocirculatory asthenia. Functional gastrointestinal disorders act in the same way as the cardiovascular ones (20) (21). This is true both of cases of neurocirculatory asthenia and of tuberculosis. Dr. Fishberg expresses a similar opinion on the nature of the gastrointestinal symptoms in tuberculosis, and with these the cardiovascular symptoms may be paralleled, when he says in his book, "Digestion in phthisis usually depends on the condition of the gastrointestinal tract before the onset of the lung disease" (22).

CONCLUSIONS

The functional disturbances of the circulatory, alimentary, and nervous systems in the tuberculous are not a specific manifestation of tuberculosis, but are usually conditioned by a constitutional nervous in-

stability of the patient. At times they may appear without such an underlying predisposition, and then may bear some relationship to hyperactivity of the thyroid gland.

The epinephrin test is of no value in the differential diagnosis of doubtful cases of tuberculosis and hyperthyroidism. First, it is not a specific test for the latter condition, but betokens only a heightened sympathetic irritability. It may be positive in cases of frank tuberculosis. Second, symptoms of hyperthyroidism, including goitre and eye signs, occur in a certain number of cases of early tuberculosis, and may possibly represent a defense reaction of the organism to the infection.

Patients in whom vasomotor and other functional disturbances are latent, and in whom they are activated by the tuberculous infection, belong to the same group as, and are analagous to, those with neurocirculatory asthenia.

REFERENCES

(1) Sewall, H.: Occult tuberculosis. Amer. Rev. Tuberc., 1920, iii, 665.

(2) Head, G. D.: Neurasthenia and tuberculosis (concealed). J. A. M. A., 1914, lxiii, 996.

(3) Papillon, G. E.: La neurasthénie prétuberculeuse. Arch. d. sciences méd., 1900, v, 19.

(4) Engel: Über den Einfluss der chronischen Lungentuberkulose auf Psyche und Nerven. Münch. Med. Wchnschr., 1902, xlix, 1383, 1424.

(5) Solis-Cohen, M.: A study of the signs and symptoms of autonomic disturbance occurring in tuberculosis. Amer. Rev. Tuberc., 1917, i, 289.

(6) Deutsch, J. and Hoffmann, O.: Untersuchungen über das Verhalten des vegativen Nervensystems bei tuberkulösen Erkrankungen der Lunge. Wien. klin. Wchnschr., 1913, xxvi, 569.

(7) Jessen, F.: Lungenschwindsucht und Nervensystem. 1905, Gustav Fischer, Jena.

(8) von Muralt, L.: Die nervösen und psychischen Störungen der Lungentuberkulösen. Med. Klin., 1913, ix, 1814, 1901.

(9) Dubois: Neurol. Centralbl., 1913, xxxii, 1122.

(10) von Brandenstein, H.: Basedowsymptome bei Lungentuberkulose. Berl. klin. Wchnschr., 1912, xlix, 1840.

(11) Biolakur, F.: Basedowsymptome als Zeichen Tuberkuloserinfektion, und ihre Bedeutung für die Diagnose und Therapie der Lungenschwindsucht. Zeitschr. f. Tuberk., 1910, xvi, 567.

(12) Saathoff, L.: Thyreose und Tuberkulose. Münch. med. Wchnschr., 1913, lx, 230.

(13) Goetsch, E.: Newer methods in the diagnosis of thyroid disorders. N. Y. State Journ. Med., 1918, xviii, 259.

(14) Goetsch, E. Recent advances in the diagnosis and treatment of thyroid disease based on the use of the adrenalin test. N. Y. State Journ. Med., 1920, xx.

(15) Boas, E. P.: The relation of neurocirculatory asthenia to hyperthyroidism as determined by the effects of the injection of epinephrin. Arch. Int. Med., 1919, xxiv, 419.

(16) Wearn, J. T., and Sturgis, C. C.: Effects of epinephrin in soldiers with irritable heart. Arch. Int. Med., 1919, xxiv, 247.

(17) Peabody, F. W., et al.: The basal metabolism in cases of the "irritable heart of soldiers." Med. Clin. North Am., Sept., 1919.

(18) Nicholson, N. C., and Goetsch, E.: The differentiation of early tuberculosis and hyperthyroidism by means of the adrenalin test. Amer. Rev. Tuberc., 1919, iii, 109.

(19) Wearn, J. T.: Epinephrin hypersensitiveness in hyperthyroidism. Meeting, N. Y. Academy of Medicine, April 1, 1920.

(20) Boas, E. P.: On the nature of neurocirculatory asthenia. N. Y. Med. Journ., 1919, cx, 273.

(21) Kantor, J. L.: Experiences with a gastrointestinal service in an army hospital. Military Surgeon, May, 1920, xlvi.

(22) Fishberg, M.: Pulmonary tuberculosis. Phila. & N. Y., Lea & Febiger, 1919, p. 225.

STUDIES ON THE INHIBITORY ACTION OF SODIUM CINNAMATE IN TUBERCULOSIS

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It has been pointed out in previous contributions (1) that the study of the chemotherapy of tuberculosis can well be divided into the study of the direct action of the substance under investigation and the study of its indirect action. In considering the direct action of a substance upon tubercle bacilli there are two modes which must be under consideration, a specific bactericidal and a specific growth inhibitory action. Sodium cinnamate called *Hetol* by Landerer, who carried on extensive investigations with this substance, was mainly considered by him as an indirect therapeutic agent toward tuberculosis, capable of effecting an inflammatory reaction around the tubercle and thus indirectly acting upon the tubercle bacilli and favorably affecting the disease.

Landerer was one of the pioneer chemotherapeutists in the field of tuberculosis and although most of his early studies were of a clinical nature and were applied to external tuberculosis he was keenly interested in finding a substance which would affect internal tuberculosis and could be administered by the intravenous route.

He had worked with iodoform, bismuth subnitrate, zinc oxide and some other commonly advocated chemicals, when finally in 1888 balsam of Peru was called to his attention as a result of the studies of the American surgeon and orthopedist, Sayre. The results obtained by him (2) upon external tuberculosis were so favorable that he was encouraged to use this substance on internal tuberculosis. His greatest difficulty was encountered, however, in obtaining a satisfactory emulsion or solution for injection; so that in 1890 (3) he began to use cinnamic acid, a constituent of balsam of Peru, which could be prepared synthetically and in chemically pure form. Finally in 1893 (4) he changed to a solution of sodium cinnamate (*Hetol*), the sodium salt instead of the emulsion of cinnamic acid. Its advantages were many. The salt was soluble in water to the extent of 5 per cent. It was nontoxic, could be sterilized easily and could be prepared in pure form; and, if anything,

it gave better therapeutic results than the cinnamic acid. Landerer and his co-workers (5) concluded that cinnamic acid and its salts were strongly positive chemotactic substances producing a marked leucocytosis and hastening the healing of tuberculosis in the lungs of rabbits and man (5) by the natural methods of walling off, encapsulation and scar tissue formation. Landerer never claimed *Hetol* to be a specific for tuberculosis but merely believed that it had a special action on diseased foci due to its accumulation at these sites.

Landerer's method of treating pulmonary tuberculosis has finally fallen into disuse for lack of satisfactory conclusive data corroborating its efficacy. It was not with any idea of repeating Landerer's work that the following investigations were carried on; but rather to elaborate on the studies with sodium cinnamate, since some encouraging preliminary studies seemed to indicate that this compound still possessed possibilities, mainly on account of its low toxicity, as an inhibitory agent in tuberculosis. Two other facts seemed also to make this work desirable, namely, the impurity and toxicity of preparations obtainable on the market, both of German and American make of so called highest chemical purity, and the adherence to only comparatively small doses according to Landerer's technique.

It was found that the ordinary American preparations of sodium cinnamate were comparatively very toxic while even the Merck's best grade (special label) had a distinct benzaldehyde odor and, since benzaldehyde is highly toxic, it should be possible of further purification. The usual method of preparation of cinnamic acid as given in most reference books is identical with that given by Fischer (6). Twenty grams of benzaldehyde, 30 grams of freshly distilled acetic anhydride and 10 grams of dry powdered sodium acetate are boiled over an oil bath, under a reflux condenser for eight hours. The hot mass is then poured into 4 to 5 times its amount of water, and steam is passed through this until all the unchanged benzaldehyde is driven off. There separates from the remaining mass, made up of water, acetic acid and a suspended oil; and, upon cooling, large amounts of cinnamic acid. To the mixture is added without filtering, and while still warm, an excess of sodium hydroxide. The sodium cinnamate thus formed is then filtered while hot from the oil. The filtrate after cooling is acidified with hydrochloric acid, when cinnamic acid again separates out, and can then be obtained by filtration and repurified by one or two recrystallizations from hot water. It was found necessary, however, to remove all the benzaldehyde

so that after the above preparation steam had to be passed through the hot cinnamic acid for at least several hours and repeated for about from 4 to 6 times (filtering the solution while hot, allowing to cool and filtering again and adding a fresh portion of distilled water, and heating and passing steam through the hot solution). The final product after from 4 to 6 such treatments possessed no odor of benzaldehyde and was then cautiously neutralized with pure sodium hydroxide, after which the sodium cinnamate was recovered by evaporation and was kept for use in dry form. This product possessed practically no toxicity. Rabbits would tolerate intravenously a single injection of 1 to 2 grams of

TABLE 1

The tuberculocidal action of pure sodium cinnamate

PRELIMINARY INCUBATION		RESULTS OF GUINEA PIG INOCULATION			
Concentration of sodium cinnamate mgm. per cc. mixture	Period of incubation of tubercle bacilli plus sodium cinnamate	Culture 1687 human 0.000,001 mgm. per injection		Culture 1000 human 0.000,001 mgm. per injection	
		Series A	Series B	Series A	Series B
	days				
20	3	+++	+++	++	+
	1	+++	++	+++	+++
10	3	+++	++	+++	++
	1	+++	+++	++	+++
5	3	+++	+++	++	+++
1	3	++	+++	+++	+++

\+ Distinctly enlarged local and slightly enlarged retroperitoneal glands.

++ Enlarged local and retroperitoneal glands and slight involvement of the spleen.

+++ Enlarged local and retroperitoneal glands, spleen markedly involved, the peritracheal glands enlarged and the lungs slightly involved.

sodium cinnamate (prepared as above) per kilo given in 5 or 10 per cent solution.

Landerer (7) states that sodium cinnamate possesses no bactericidal power upon the tubercle bacillus, but he gives no detailed experiments. This is, however, corroborated in the following experiment, at least in so far as concentrations attainable in the body are concerned.

Suspensions of 0.000,001 mgm. of virulent human tubercle bacilli (laboratory strains no. 1687 and no. 1000) were treated with varying concentrations of sodium cinnamate from 1 to 20 mgm. per cubic centimeter. The mixture which was then incubated at 37°C. for one to three

days was subsequently injected into guinea pigs. After six weeks the animals were examined, when it was observed that the preliminary treatment of tubercle bacilli with sodium cinnamate, prior to injection into guinea pigs, appeared to have no bactericidal action on the tubercle bacilli, as evidenced by the course of the disease in the animals (table 1).

The above experiment indicates that even in 2 per cent concentration and an exposure of three days, sodium cinnamate possesses no tuberculocidal power. In order to note in what concentration sodium cinnamate possesses growth inhibitory power a series of tubes of 5 per cent glycerine agar was prepared, containing varying concentrations of sodium cinnamate; and these were seeded with human tubercle bacilli and incubated at 37°C. for one month when they were examined for growth with the results given in table 2.

TABLE 2

Growth inhibitory power of sodium cinnamate in glycerine agar

	CONCENTRATION OF SODIUM CINNAMATE (MGM. PER CC.)							
	5	3	1	0.5	0.1	0.05	0.001	Controls
Culture 1687	–	–	–	–	+	++	++	++
	–	–	–	–	–	++	+	++
Culture H	–	–	–	–	+	++	++	+
	–	–	–	–	–	++	++	++

Cultures were examined for growth one month after seeding.

These results were encouraging since the low toxicity of sodium cinnamate by intravenous injection made it seem highly probable that a concentration of 0.5 mgm. per cubic centimeter of the blood (or body fluids) could be obtained and probably maintained for some time. Sodium cinnamate, being a crystalloid, would also insure a rapid general distribution throughout the body (8).

In order to be able to determine the concentration of sodium cinnamate in the tissues, and especially in the blood, the following rapid method was developed and used for this purpose. The sample of blood to be analyzed was diluted with ten volumes of pure methyl alcohol and was allowed to stand two hours, which precipitated all the proteins. The filtrate containing the sodium cinnamate was then evaporated to dryness on a water bath and the residue was dissolved in a definite volume of distilled water. A series of dilutions was then made from this solution, which by preliminary test would reveal about 0.2 to 1.0

mgm. sodium cinnamate per cubic centimeter. The sodium cinnamate content of the solution was then determined by comparing the unknown in various dilutions with known solutions, with contents of sodium cinnamate graded by 0.1 mgm. from 0.2 to 1 or 2 mgm. per cubic centimeter, using for test the density of the precipitate produced by contact with a superimposed solution of pure dilute hydrochloride acid (about a normal solution). This method proved sufficiently accurate for practical purposes, and allowed readings accurate to within tenths of a milligram in the range of 0.2 to 2 mgm. per cubic centimeter of solution.

In preliminary experiments it was found that 1.25 grams per kilo of pure sodium cinnamate given intravenously to the rabbit was still consistent with life. In order, therefore, to determine what concentration of sodium cinnamate could be attained in the blood and its persistence there, a series of rabbits was given intravenous injections

TABLE 3

The persistence of sodium cinnamate in the blood of rabbits after intravenous injection

AMOUNT OF SODIUM CINNAMATE PER KILO GIVEN INTRAVENOUSLY	SODIUM CINNAMATE CONTENT OF THE BLOOD MGM. PER CC.							
	Before	After						
		30 seconds	1 minute 30 seconds	2 minutes 30 seconds	3 minutes 30 seconds	4 minutes 30 seconds	6 minutes 30 seconds	22 seconds
1.25	0.0	8.5	2.3	1.8	1.5	1.1	0.8	0.1
1.00	0.0	6.0	2.1	1.5	0.9	0.7	0.6	0.2

of 5 per cent sodium cinnamate (1.25 grams per kilo) and the blood was analyzed before and at various intervals thereafter with the result given in table 3 (two typical cases).

From these experiments it is to be noted that sodium cinnamate, given intravenously to rabbits, disappears gradually and completely from the blood within a day and therefore must be administered continuously if a concentration is to be maintained for any length of time, as might be necessary to exert an inhibitory influence upon the tubercle bacillus. In order to note whether any pathological effect was produced by the prolonged intravenous administration of sodium cinnamate, several rabbits were given three and four injections of 0.5 gram per kilo of sodium cinnamate daily for six days without any visible effect. This seemed encouraging and made possible the continuous intravenous injection of sodium cinnamate. Before attempting this, however, it seemed desirable to study the inhibitory action of sodium cinnamate

contained in the blood of rabbits. For this purpose a rabbit was given an intravenous injection of sodium cinnamate and blood was drawn at intervals, its cinnamate content determined, and it was then either inspissated after the addition of 5 per cent glycerol and used as a culture medium, or it was mixed using sterile precautions with one fourth volume of 20 per cent glycerol 6 per cent agar and slanted to give a solid medium. These mediums were then seeded with human tubercle bacilli, incubated at 37°C. for eight weeks, and read with the results given in table 4.

It is noted from this experiment that rabbits blood, containing between 1 and 2 mgm. of sodium cinnamate, possesses growth inhibitory properties toward human tubercle bacilli. Therefore, if this concentration of the cinnamate could be maintained over a long period of time without

TABLE 4

The growth inhibitory action of sodium cinnamate, contained in the blood of rabbits after intravenous injection, upon human tubercle bacilli

CONCENTRATION OF SODIUM CINNAMATE (MGM. PER CC. OF BLOOD)	INSPISSATED BLOOD PLUS GLYCEROL	FRESH BLOOD PLUS AGAR PLUS GLYCEROL
0.0	+++*	+++
6.0	−	−
2.5	−	−
1.6	+	±
1.0	++	+
0.8	++	++
0.5	+++	+++

* These results are graded from + to +++ and are the mean readings of three tubes inoculated.

harm to the animal, it should be of definite therapeutic value. In order to test whether a concentration of between 1 and 2 mgm. of sodium cinnamate in the blood could be maintained over a long period of time, recourse was first had to the Woodyatt continuous injection apparatus (9), but it was soon found that this instrument could not be used continuously for more than twenty to thirty hours. Another method of injection was devised which, though not as accurate, could be used, with care, over an indefinite period.

Continuous injection apparatuses, in which the pressure is imparted by a chamber of compressed air, have been described by Kritchmer (10) and Rhodes (11). Our apparatus consists of a burette with side arm, the top of the burette being connected with a pressure tank, the side arm to the reservoir for the fluid to be injected, and the outlet directly

with the injecting needle. Fluid is permitted to run into the burette from the reservoir, which is then closed off by a pinch clamp and pressure from the tank applied. A useful pressure regulator was found in a column of mercury into which was placed the open end of a glass tube

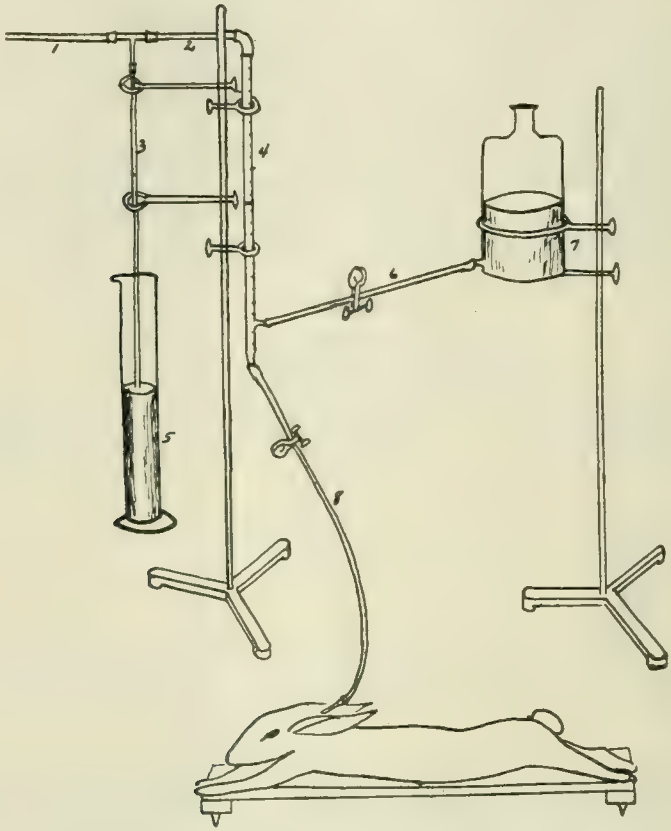

Fig. 1. Diagram of Continuous Injection Apparatus

1, tube leading to pressure tank; *2*, continuation of tube 1 leading to burette; *3*, side arm from tube 1 leading into mercury column; *4*, burette in which fluid is kept under constant pressure; *5*, mercury column; *6*, connecting tube between burette and reservoir; *7*, reservoir for fluid given intravenously; *8*, outlet from burette, for direct connection with vein to be injected.

connected by means of a T tube directly with the outlet from the pressure tank. The pressure could then be altered by raising and lowering the open end of the glass tube in the mercury column, the maintained pressure was equal to the column of mercury above the open end of the glass tube.

In order to determine how long a concentration of 1 and 2 mgm. could be maintained in the blood of the rabbit by continuous injection, using the apparatus described above, a series of experiments was planned and carried out, in which two rabbits in each series were given continuous injections of sodium cinnamate (2.5 per cent) intravenously. The blood was analyzed at frequent intervals throughout the experiment and the water intake and excretion carefully noted. During these injections the rabbits were held in a special box, their heads being held in a stock, so that the animal could eat and sleep during the injections

TABLE 5

The effect of sodium cinnamate on citrated rabbit, dog and human blood

VOLUME SODIUM CINNAMATE IN SALINE	DILUTION OF SODIUM CINNAMATE	VOLUME OF BLOOD	FINAL CONCENTRATION OF SODIUM CINNAMATE: GRAMS PER CC. MIXTURE	RABBIT			DOG			HUMAN		
				Reaction at twenty-four hours			Reaction at twenty-four hours			Reaction at twenty-four hours		
				Hemolysis	Color	Gel formation	Hemolysis	Color	Gel formation	Hemolysis	Color	Gel formation
cc.		*cc.*										
0.9	1–10	0.1	0.0900	++++	C B	+	++++	C B	+	++++	C B	+
0.7	1–10	0.3	0.0700	++++	C B	++	++++	C B	++	++++	C B	++
0.5	1–10	0.5	0.0500	++++	C B	++++	++++	C B	++++	++++	C B	++++
0.3	1–10	0.7	0.0300	++++	C B	++++	++++	C B	++++	+++	C B	++++
0.1	1–10	0.9	0.0100	++	R	+	++	B R	+	++	B R	+
0.1	1–12.5	0.9	0.0080	+	R	0	+	R	0	+	R	0
0.1	1–15	0.9	0.0066	+	R	0	+	R	0	+	R	0
0.1	1–20	0.9	0.0050	+	R	0	+	R	0	0	R	0
0.1	1–25	0.9	0.0040	0	R	0	0	R	0	0	R	0
0.1	1–30	0.9	0.0033	0	R	0	0	R	0	0	R	0
0.1	1–40	0.9	0.0025	0	R	0	0	R	0	0	R	0
0.1	1–50	0.9	0.0020	0	R	0	0	R	0	0	R	0
0.1	1–80	0.9	0.0012	0	R	0	0	R	0	0	R	0
0.1*		0.9	0.0000	0	R	0	0	R	0	0	R	0

C = chocolate; B = brown; R = red.

* Saline control.

without inconvenience. The difficulties encountered during the first few days were few, and were mainly the complete occlusion of all the ear veins so that the injections had to be discontinued. Several rabbits were, however, successfully injected until the fourth day when there would occur either an edema of the ears making further injection impossible, or the rabbits would become weak and there would be a marked retention of water, or the serum upon separation from the corpuscles by centrifugating would be distinctly pink as a result of *in vivo* hemolysis of the erythrocytes.

One rabbit of this series, the longest experiment carried out, was given, during a period of eighty-three hours, 950 cubic centimeters of 2.5 per cent sodium cinnamate (a total of about 24 grams) intravenously. The blood content of sodium cinnamate ranged between 0.8 and 1.6 mgm. per cubic centimeter during the entire period of experimentation. The experiment had to be stopped on account of the poor condition of the animal and the blood revealed a decided grade of hemolysis. The animal died two days later.

In order to note whether this hemolytic action of sodium cinnamate, the main contraindication to its use as a therapeutic agent, occurred *in vitro* its action in different concentrations was studied upon rabbit, dog and human whole citrated bloods with the results given in table 5.

Sodium cinnamate in higher concentrations (1 to 9 per cent) gels the blood and effects the hemoglobin (as indicated by the change in color to chocolate brown) of rabbit, dog and human whole citrated blood. In still weaker concentrations, 0.5 to 1 per cent, it produces a distinct hemolysis.

SUMMARY AND CONCLUSIONS

Repurified sodium cinnamate, in concentrations up to 2 per cent, has no tuberculocidal action within three days, but is distinctly inhibitory to human tubercle bacilli in 5 per cent glycerine agar in a concentration of 0.05 per cent, while in rabbit blood medium, both fresh and inspissated, it is inhibitory only in a concentration of about 0.2 per cent.

Pure sodium cinnamate does not persist in the blood of rabbits after a single intravenous injection (1.0 to 1.25 grams per kilo) for more than one day, being present in a concentration of from 0.6 to 0.8 per cent after one-half hour, from 0.1 to 0.2 per cent after three hours, from 0.06 to 0.08 per cent after six hours, and from 0.01 to 0.02 per cent after twenty-two hours.

By continuous intravenous injection of a 2.5 per cent solution of pure sodium cinnamate a concentration of 0.08 to 0.16 per cent of the blood can be maintained for a period of eighty-three hours in the rabbit. On account of its hemolytic action when administered over a prolonged period of time (exceeding three days) sodium cinnamate cannot be used as an inhibitory agent in tuberculosis.

In vitro sodium cinnamate has both a hemolyzing and geling action upon the whole citrated bloods of rabbits, dogs and human beings.

REFERENCES

(1) Corper, H. J.: The reaction of the local tubercle. Amer. Rev. Tuberc., 1917, i, 407, and Effect of tethelin on experimental tuberculosis. J. Infect. Dis., 1917, xxi, 269.

(2) Landerer, A.: Die Behandlung der Tuberkulose mit Perubalsam. Deut. med. Wochschr., 1890, xvi, 280 and 312.

(3) Landerer, A.: Die Behandlung der Tuberkulose mit Zimtsäure. Verlag von F. C. W. Vogel, Leipzig, 1898, p. 12.

(4) Landerer, A.: Anweisung zur Behandlung der Tuberkulose mit Zimtsäure. Verlag von F. C. W. Vogel, Leipzig, p. 16.

(5) Richter, P.: Virchows Archiv, 1893, cxxxiii, 376.

(6) Fischer, E.: Anleitung zur Darstellung organischer Präparate. Verlag von Friedr. Vieweg & Sohn, Braunschweig, seventh edition, 1905, p. 37.

(7) Landerer, A.: Die Behandlung der Tuberkulose mit Zimtsäure. Verlag von F. C. W. Vogel, Leipzig, p. 58.

(8) Wells, H. G., and Hedenburg, O. F.: The permeability of tubercles for iodin compounds and proteins. J. Infect. Dis., 1912, ii, 349.

(9) Woodyatt, R. T.: The method of timed intravenous injections. J. Biol. Chem., 1917, xxxix, 355.

(10) Kritchmer, W.: Arch. Exp. Path. u. Pharm., 1907, lvii, 428.

(11) Rhodes, E.: Z. biol. Tech. u. Method., 1913, iii, 85.

AN UNUSUAL CASE OF PULMONARY TUBERCULOSIS, WITH ONSET IN THE LOWER AND SPREAD TO THE UPPER LOBE

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This case is reported on account of the rarity of the condition. Aside from acute tuberculosis, initial lower lobe involvements, in adults at any rate, are seldom encountered.

Miss K., age twenty-seven, first seen October, 1919, had been under treatment for pulmonary tuberculosis off and on for two years. Onset gradual. Had no recollection of bacterial findings at start of illness but thought sputum had been positive. Chief complaints were fever, cough, expectoration and annoying wheezing, but with no distinct asthmatic paroxysms. Examination revealed a moderately dense infiltration of the lower lobe of the left lung with subcrepitant and indeterminate râles. In addition, coarse moist musical râles were heard all over both chests. Both isthmi found narrow, and left complemental space practically obliterated. A diagnosis was made of chronic bronchiectasis, with tuberculosis doubtful on account of the unusual location of the only consolidation present. The first X-ray taken October 27, 1919, showed a typical tuberculous bronchopneumonic infiltration of the lower lobe of the left lung with absence of disease in the upper lobe. Repeated sputum examinations invariably showed large numbers of tubercle bacilli.

Two alveolar abscesses were considered the probable etiology for the bronchiectasis and appropriate surgical measures were instituted. Clinical and physical signs of the bronchiectasis gradually cleared up completely in the course of the next few months, but cough and positive sputum persisted; and it was noticed that the subcrepitant basal râles and dulness were gradually spreading over the upper lobe, where such physical signs had previously been nonexistent. A second X-ray taken, March 12, 1920, some five months later, confirmed the diagnosis of this unusual order of tuberculous disease extension. It also revealed a lessened density in the hilum region, coincident with the clearing up of some of the old consolidation, which was probably related to the bronchiectasis and was nontuberculous in character.

Fig. 1. First X-Ray, Showing Disease Confined to Lower Lobe of Left Lung

Fig. 2. Second X-Ray, Five Months Later, Showing Extension to Upper Left Lobe

SPONTANEOUS PNEUMOTHORAX FOLLOWING ARTIFICIAL PNEUMOTHORAX

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The bibliography of this interesting subject is so well taken up by C. H. Cocke in a recent number of this journal (1) that I shall do no more than report the four following similar cases from my own practice, as it is my impression that a free reporting of this complication by pneumothorax operators would demonstrate its occurrence more frequently than is generally believed.

Case 1. Mrs. R., age thirty, entered the Von Ormy Sanitarium May 5, 1919, a tuberculosis case with considerable activity of the entire left lung, complicated by moderate activity of the upper lobe, right side. Sputum positive. Previous history unimportant except for asthma and several intranasal operations for polypi and hypertrophied turbinate bones. Under rest cure the case progressed rather unfavorably. Artificial pneumothorax on left side was easily induced on September 18, 1919, subsequent refills being of small size on account of activity on the other side. Physical examinations and X-ray studies showed the compression only partial, and not extending above the 2nd rib or 3rd dorsal spines on account of adhesions. Nevertheless, clinical improvement was rather remarkable, even though by the end of December, 1919, the manometer reading at the close of refills was not permitted to pass the neutral. Previous fever disappeared completely. On January 4, 1920, a routine refill operation was easily performed. The reading at the start of the operation was minus 3. Following the injection of 250 cc. of air it was neutral, and followed by the usual decline in cough and expectoration. Six days later the patient had several persistent uncontrollable sneezing spells as had been the case on several previous occasions, in the course of which pain in left side developed, with considerable respiratory distress which increased next morning. The patient became restless and decidedly more ill with a sharp rise of temperature. Physical examination revealed absence of pleuritic rub or fluid, and only the usual pneumothorax, with the heart border considerably further than usual to the right. A diagnosis of spontaneous pneumothorax was made, on account of the clinical and physical signs. It was not complete, on account of upper lobe adhesions.

X-ray studies at the time were not available. Symptoms continuing without abatement for four days, on January 14, an exploratory chest puncture was performed with the idea that by this time the spontaneous pneumothorax opening had had time to close. Intrathoracic pressure, averaging plus $2\frac{1}{2}$, was immediately obtained, which was quite a difference from the usual which had never been over neutral. Two hundred cubic centimeters of air was immediately withdrawn, resulting in a manometer reading of minus $\frac{1}{2}$. Respiratory and other distressing symptoms were at once relieved, the temperature also falling at once. The original pneumothorax opening remained closed, as was shown by an intrathoracic pressure of minus 1 five days later, which was changed to plus 1 by 75 cc. of air, probably on account of fluid, insufficient for clinical detection. Nine days later 280 cc. of air changed the pressure reading from minus 5 to plus 1. The subsequent history of the case to date reveals no further interest in this connection.

Case 2. R. B., Base Hospital, Ft. Sam Houston, no. 78007. Diagnosis: Pulmonary tuberculosis, involving all lobes both lungs. Acute pneumonia in type upper lobe, right lung. Confirmed by laboratory and radiographic studies. Extremely sick case. Left artificial pneumothorax was easily induced on April 21, 1919, 600 cc. of air being given. This unusually high amount was given on account of the desperate nature of the case and to secure immediate compression if possible. Previous treatment, intravenous glucose solutions. Immediate results good, with considerable drop in temperature and amelioration of clinical symptoms. On April 26, five days later, the temperature suddenly rose to 104° with considerable pain in right chest, shortness of breath and moderate cutaneous emphysema. The heart was noted considerably further dislocated to the left than was previously the case. A diagnosis was made of spontaneous pneumothorax complicating induced pneumothorax, and this was confirmed by the X-ray. For three weeks thereafter, this case hovered between life and death, as is the rule in these spontaneous pneumothorax cases. Operative interference was deemed inadvisable. Then the temperature dropped by lysis to normal in the next few weeks with complete diasppearance of cough and expectoration, subsequent to the development of the effusion that followed. There was no clinical indication at any time for the removal of this effusion. However, to the intense disappointment of all of us coming into contact with this case which had promised such a remarkable recovery, a hemolytic streptococcus pharyngitis ensued, following four weeks of normal temperature. After a persistence of fever for several days paracentesis revealed a similarly infected chest exudate, which ultimately terminated fatally in spite of rib resection and temporary improvement. The spontaneous pneumothorax in this case, in my opinion, was due to the giving away of pulmonary interstitial tissue at the insertion of a long narrow tongue like fibrous adhesion situated close to the apex.

Case 3. N. K., Base Hospital, Ft. Sam Houston, no. 82551. Very sick case with large spontaneous pneumothorax, cavity occupying upper quarter left chest, with extensive disease extending into base, and apparently pneumonic in type. Sputum positive. Intrathoracic diagnosis also confirmed radiographically. As a last resort, artificial pneumothorax was performed with the idea of compressing the lower lobe. On August 5, 1919, three days after admission, 300 cc. was easily introduced, resulting in a slight negative pressure reading, the operating needle obviously missing the spontaneous pneumothorax cavity. A few hours later, respiratory distress became acute, considerable cutaneous emphysema, previously absent, developed, and the heart was noticed much further to the right than at the close of the induced pneumothorax. The X-ray revealed two pneumothorax cavities in the same chest, apparently not communicating, but actually probably so. There was first, the original unchanged old spontaneous pneumothorax and below this a huge pneumothorax with mediastinal displacement out of all proportion to the amount of air introduced. Attempts to remove the air revealed a valvular spontaneous pneumothorax (manometer pressure readings could be changed during the operation); but cardiac percussion a few hours later invariably revealed displacement at least 2 inches greater than at the close of any operative procedure. Pyothorax developed with early fatal outcome.

Case 4. Miss B., age twenty-five. Seen January, 1915. Owing to the fact that many of my records have been misplaced, I am able to give only such meagre details of this case as are shown by the temperature record. This was a typical septic type of tuberculosis with very wide temperature remissions. On February 18 this young woman developed a complete spontaneous pneumothorax with the usual shock and subsequent symptoms, including cutaneous emphysema, followed by a rather considerable temporary improvement. Cutaneous and intrathoracic air seeming to absorb rapidly and upon unfavorable clinical symptoms returning, I decided to increase the amount of air in the chest. On March 7, 1915, 250 cc. were given. For three days thereafter, the temperature remained a little lower with some clinical improvement; but on March 10, following cough, she developed sudden pain in the chest with extreme respiratory distress and collapse. Cardiac displacement was made out, and this increased with a return of marked cutaneous emphysema heretofore absent following operation. X-ray study unavailable. The subsequent temperature in this case reached 105°. The patient ultimately developed an effusion. Her temperature dropped gradually by lysis. She improved sufficiently to permit of her returning to work for several years; but died ultimately of tuberculosis about two months ago.

If there is any lesson to be learned at all from a study of these cases, it is, first of all, merely a confirmation of what is now well known,

namely, that 600 cc. of air is much too large an injection for an initial dosage, and in the cases of previous spontaneous pneumothorax,—if operated on at all,—250 to 300 cc., as was given, is also far too large an initial dosage if we take into consideration the fact that we have at our command only a fraction of the original thoracic cavity to hold our injected air or gas. Secondly, following a spontaneous pneumothorax, immediate attempt to relieve the intrathoracic pressure, as was done in case 3, is not nearly as advisable as waiting a few days if possible, as was done in case 1, in order to give the spontaneous tear a chance to close, and keeping the case under these circumstances a closed rather than an open pneumothorax with subsequent almost certain infection and hopeless prognosis.

For the avoidance of spontaneous following artificial pneumothorax, in addition to the avoidance of all but minimum initial inflations of not over 300 cc., some assistance in this connection undoubtedly can be secured by the use of heroin or codein to allay the irritating cough that is at times induced.

REFERENCE

(1) Cocke, C. H.: Spontaneous pneumothorax following artificial pneumothorax, with operation and recovery. Amer. Rev. Tuberc., 1920, iii, 781.

ON PERSONAL EXPERIENCE

AND THE VALUE OF A MEDICAL SOCIETY TO ITS MEMBERS[1]

LAWRASON BROWN

There is a tide in the affairs of men, whether banded together for the pursuit of politics, of government, or indeed of medical science, which taken at the flood leads to success: abandoned, all the voyage of life is bound in failure and in petty conceits, if I may so express it.

The success of a medical society depends upon many and varying factors. The first and foremost, to my mind, is whether the society has originated for the immediate benefit of its founders and for them alone. Such a society may wield a great, but rarely any lasting, influence, and dies with the decease of its charter members. Such organizations are hardly ever national in scope, and for us to-day need but passing mention.

Vision, in a broad sense, is not a common attribute of man. It makes a statesman out of the politician; an intrepid investigator, or even a genius, out of the medical worker. The medical society whose directors possess vision is a society planned on other lines certainly than the one I have mentioned. I am in no position, I do not possess the qualifications, to describe to you the ideal medical society. I do want, however, in this address to you, to make a few suggestions which may or may not meet with your approval and which you may or may not wish to consider and weigh.

The first and foremost function of any medical society, as I see it, is to bring together medical workers. When a man works alone, thinks alone, plans alone, he devises at times ingenious contrivances, invents occasionally wonderful mechanisms, makes now and then significant medical discoveries; and then fails, through his aloofness, to be able to force upon his fellow workers the real value of his contributions.

Look at one of your lonely, industrious fellows for a moment, I beseech you. He sows hurry and reaps indigestion; he puts a vast deal of activity out to interest, and receives a large measure of nervous derangement in return.

[1] Presidential address delivered at the annual meeting of the American Climatological and Clinical Association, Philadelphia, June 17, 1920.

Either he absents himself entirely from all fellowship, and lives a recluse in a garret, with carpet slippers and a leaden ink-pot, or he comes among people swiftly and bitterly, in a contraction of his whole nervous system, to discharge some temper before he returns to work. I do not care how much or how well he works, this fellow is an evil feature in other people's lives. They would be happier if he were dead. . . . . He poisons life at the well-head.

The failure of many wonderful medical discoveries to be properly recognized, when first announced, can often be traced to some such trait as I have mentioned. Recall for instance, Auenbrugger and percussion, Mendel and heredity, Beaumont and digestion, Long and anaesthesia, or Lower and Mayow and oxygenation of the blood.

Free intercourse then among medical workers is essential to the development of our investigators' highest qualities, and aids the physician in his progress toward the highest medical attainments. The medical society of to-day is usually composed of men interested in more or less similar lines, in more or less closely allied medical problems. In recent times we have heard much of the group study of patients. A medical society should function along somewhat similar lines. Each of us may present a contribution which we hope adds something to medical knowledge, and if we are not overworked, overwrought, we welcome friendly criticism. I must acknowledge that it is rather trying even then to have a fellow member rise to ask us blandly a question, of which the significance may not at once dawn upon us, but which leads us to ponder over our thoughtlessness in overlooking an essential side of the question, which may weaken or even negate our thesis. We deserve the humiliation; and, taken in the right spirit, it enables us to rise on our own errors.

Another very important function of all medical societies is the familiar intercourse they facilitate and engender among their members. During the course of the year many problems have arisen; and here is a clearing house for half-baked ideas and problems. Here too we can meet authorities who can solve many of our difficulties out-of-hand. Who has not formulated opinions in these very valuable moments of intimate discussion, opinions which really astonish himself after he has uttered them? I am not sure but that it would be a wise thing if we could have more informal discussion when the younger men could ply with questions their older fellow-members. Some scheme would have to be devised by which exclusive cliques could be avoided, for such a disease saps the energy of the most vigorous society.

Social intercourse among physicians is a melting pot in which much dross of imagined personal slight is consumed by the rapid fire of pleasantries or by frank explanation in a few simple words. Here again informality is invaluable. "Dr. Smith," we say, "is not quite the bad and impossible fellow we thought him;" and then after a moment add a cubit to our own growth by continuing, "He has greatly improved." Others may see that we have outgrown Smith in improvement.

I have spoken of vision and of the growth of medical societies; and now a word upon their propagation or, if you will, their self-perpetuation. To me the vital points in this regard appear to be first, the proper selection of new members; second, their proper cultivation; third, the graceful retirement, into a group, of emeritus members, whose privileges would be little curtailed, but whose dues might be greatly mitigated,—of those who have borne the heat of the fray for years, who might like still to be in it, but less actively of it.

The proper selection of new members devolves, of course, upon the active members. It seems to me that the fact, while of paramount importance, that a proposed member has written much, has contributed many articles to medical literature, is not enough to recommend him to our society. He must still possess the spirit which forces him to think, to try, and possibly to write. He must possess, as well, a pleasing personality; but charm of manner alone should not open the door of the society to him. Personally I do not believe in associate membership. I rather incline to the view that every applicant for membership, who receives the endorsement of the council, should be invited to meet with us, to present to us a paper, and during that meeting be treated as a member in every respect save in voting. We could then make up our minds about him and he about us. At the next meeting he could be elected to full membership if the society chose, and he of course could elect to accept or reject the membership proffered him. In the past we have unfortunately elected as members a few men who have never evinced any desire for association with us, and who probably would be greatly relieved to be freed from paying dues to a society they never intend to attend. Such membership is a weakness to any society and our rules should be stringently applied to members who have never attended but one meeting or, indeed, who have never put in a single appearance. I care little who they are: their membership means nothing to them and only injury to us.

As I grow older I feel a compelling force driving me to associate more closely with the younger medical men. Before them stretches the great future. My own horizon I see narrowing every day. They have the enthusiasm of youth, the dauntlessness of ignorance; we, the gray heads, hesitate to step where they rush in,—at times to win. I incline to keep our membership leavened with youth. We may choose the wrong man; but, if he has reached his fourth or fifth year after graduation, his friends can rather easily estimate his abilities and we can check them up for ourselves. I do not mean that men over forty should not be elected to our society, but I do maintain that they should be as carefully scrutinized as our younger members, to see that they do not suffer from early ossification of the gray matter.

If we elect a young man I do not feel that our duty to him as a society ends there. He may need encouragement. Let the president invite him to read a paper, and, if necessary, even suggest a topic. The older men should bear in mind how much the tyro appreciates a word of commendation; but do not let us be either stingy with our approbation or fulsome with our praise. Nor should we omit just criticism, but it must always be sent forth on shock absorbers.

The suggestion for an active-inactive group of members largely depends upon the view that a dilution of young blood, a transfusion, so to speak, of new blood, is necessary to carry on successfully the life processes of the society. By such a means the older members would be present with advice, counsel and contributions, and the younger men would reap the benefit and be called upon to fill the program. I would not relegate any group which I soon must join to innocuous desuetude, nor subject them to the lethal practices of the despenadora of the Aymaras.

The value of any society to its members can be roughly gauged by a study of the discussion of the papers brought before it. In many societies the discussions are what we might call very "loose." They deal too much in generalities, too little with the actual experience of its members; and I am tempted to conclude my remarks to you with a few words on "personal experience" in medicine.

Since the time when man evolved through one or more unknown types from the lower animals, personal experience has been a factor of paramount importance to the race. Its value is greatly enhanced for man on account of the long period of immaturity through which each individual

must pass. This period is one of great receptivity, one during which the personal experience of our forefathers is indelibly impressed upon our body and our mind. History is but the personal experience of great leaders of men in their relation to their followers and opponents. Biography, the most stimulating and suggestive of all forms of literature, especially for younger persons, who strange to say, often systematically neglect it, is the personal experience of an individual in regard to life in general. I could multiply these examples and enlarge upon them many times, but what I would like to make clear is that none of us is free from or can escape "personal experience." In fact, through the long years of childhood "personal experience" of our parents, of our teachers, of our associates, is made part of our own personal experience; and thus is formed that individual quality known as character. I am sure that all of you will agree with me in regard to this great value of personal experience in our daily lives. But now, since it is so important for us, it should be most carefully guarded. The individual upon whose personal experience we depend must be known to us. We must not believe that a sour-visaged, quarrelsome churl will have the same personal experience as a gay, light-hearted, pleasure-seeking, frivolous troubadour. "Laugh and the world laughs with you,—weep and you weep alone." It is here that we often go astray and pitch upon and hold up as our model some one whom the collected personal experience of many has shown to be askew. I have said enough, I hope, to have you grant me the value of personal experience and the danger at least of one fallacy that may lie concealed in it.

Personal experience in medicine is the stepping stone to success for most physicians. Few have that quality of mind that enables them to collate the personal experience of many men and so to clothe it, in words of their own, that to most of us it appears as the personal experience of the writer. This is a valuable gift and while not of the highest order is yet of great service to all of us.

Let us pause for a few minutes to consider what personal experience in medicine consists of. We no sooner revolve the phrase in our minds than the old timeworn aphorism of Hippocrates recurs to us: *Experience is fallacious and judgment difficult.* There is no one who will deny this but to acknowledge it and supinely to fold our hands is, I hold, a true attribute of agnosticism, which leads us nowhere.

You have, no doubt, many times been struck with that peculiar logic that the lay mind applies to things medical in seeking a cause for every

effect. This is peculiarly appreciated when, after carrying a patient through a protracted illness, we are discharged on the eve of recovery; and to some simple medicament given by our successor, often without the slightest effect, is attributed the recovery which we knew would in due time occur. The profession in general, however, is prone to fall into similar fallacies and nowhere do we see this more than in the effects attributed to many and varied drugs. Who can deny that at some time in his career he has attributed to some remedy effects that a wider and more extended experience forced him to acknowledge were not present? In no disease is this fallacy more often exhibited than in pulmonary tuberculosis, a long, tedious, chronic disease, where many of us would often like to join in the wish of the husband of one of Doctor Trudeau's patients, who said that he wished his wife would get well or do something. The long list of drugs that have been warmly advocated by the discoverers of their value in pulmonary tuberculosis and their subsequent failure in the hands of many unbiased observers are proof sufficient. I do not impeach the honesty of these men, for at times I must confess a close kinship to them; but the results, I believe, are to be attributed to suggestion, that most potent factor in all drugs, which explains the wonderful results of some observers and their failure when all suggestion is eliminated. Here the personal experience of one man is not sufficient and we must not allow ourselves to follow any individual blindly.

Another fallacy inherent in personal experience is the fact that we see only what we look for, and for years we may entirely pass by some important data. A single example will suffice to make this point clear. Until Reginald Fitz, not so many years ago, wrote so clearly and forcibly upon the symptoms of appendicitis and of pancreatitis they had escaped our attention. Consequently we must also know the physician and his fitness for observation before we can fully accept his personal experience.

Another fallacy lies in the fact that personal experience too often rests upon memory. I have long looked upon memory as an attribute necessary to greatness in the medical profession, but more recently I have been struck with the fact that originality and a tenacious memory are not often associated in the same individual. The very fact that an investigator at every turn recalls what A or B has done seems to have an inhibiting effect upon research. However this may be, the average individual has none too strong a memory and I cannot but believe that many slurs cast upon the medical profession or its wide divergence of views is due to the fact that the personal experience of the various opponents in

many controversies is based upon their memory of their observations. I do not want to be misunderstood and hasten to say that no one respects and admires memory more than I do, for I sorrow in a poor one; but I do affirm and stoutly maintain that, however defective your memory may be, your personal experience, if carefully noted in your case reports, has a thousand times more value than the personal experience of an equally good observer who makes no notes or does as some men have recently done. These men, very careful observers, have made numerous notes but in some of their articles have failed entirely to refer to any of these notes. Such work, hasty though it has to be, is in my opinion inexplainable. I am quarreling with no man who through sheer lack of time and rush of work makes no notes and, as long as he recognizes that his personal experience is based upon impressions and so states the case, I value his impressions; but only as impressions.

But personal impressions indeed are based upon statistics, statistics of the "failing memory," which I shall mention. Your personal impressions, you say, lead you to believe one or another symptom is common. If you analyze the mental process by which you have reached this conclusion you will not infrequently see that you have in mind all or a part of the cases you have seen, about whose exact number you are uncertain. Of this uncertain number a more indefinite proportion has exhibited the foregoing symptom and so you arrive at your personal impression, which you must acknowledge is in reality based upon faulty statistics.

You may reply to me that most medical authorities write in this way. I grant you many do, but I am much mistaken if most of their solid facts are not based upon accurately computed observations of many privates in the regiments of physic.

In no department of medicine do we find such a tremendous strain placed upon failing memory as in the records of clinical observations. I say failing advisedly, for whose memory of 1000 cases is as fresh for cases 1 to 100 as for cases 901 to 1000? The last 100 cases outweigh in our memory the first 500. On several occasions I have had to revise a manuscript in which I had made from memory certain statements which my real personal experience proved to be entirely untrue.

Have you ever thought what effect some such statement as the following would have upon you? Dr. X reported his experiments upon guinea pigs and rabbits extending over many years. He said his personal experience in these experiments led him to believe that the various drugs mentioned had markedly beneficial effects upon the infections

with which the animals had been inoculated. Dr. Y asked Dr. X how many rabbits and how many guinea pigs he had used, with what micro-organisms he had infected them, how many showed the symptoms he had described as classical and what led him to believe that the drugs used had exerted the beneficial influence he attributed to them, when it was well known that many of the infections in these small animals often terminated in spontaneous cure? To these questions Dr. X replied as follows: He thought Dr. Y's questions very pertinent. He had always had a good memory and trusted to that rather than to a careful perusal of his notes, which were very voluminous and hard reading. As he remembered, he had used several thousand animals, but regretted that he could remember neither what dose of each organism he had used nor how many animals he had inoculated with the different bacteria. He attributed recovery to the drugs he used for the reason that the animals seemed to recover more quickly although he could give neither the average time for recovery nor the exact number that recovered. Such a report would be greeted with the scorn and derision that it deserved. Yet how many of us when dealing with clinical observations do not follow such lines? I am afraid we are all too prone to do it.

Before leaving this section of my paper I must pay tribute, in one particular at least, to memory. I refer to diagnosis. Here memory is of great avail. The impression of a mistake in diagnosis long rankles in our breasts and really makes a book for our mistakes unnecessary for some of us. The cases of great rarity are also ineffaceable and these together with our impressons of our personal experience are our trusty and tried servants in the art of diagnosis.

None of you will contradict me when I say that statistics are very dry but some of you may dispute me when I say that only by statistics does the world, lay or medical, advance. Consider what knowledge is and you will see how inseparable it is from statistics. Medicine is no exact science, and diagnosis rests largely upon the law of probability which in turn is statistical. All scientific experiments are statistical arguments in favor of or in opposition to certain inductions or deductions. Further statistics lend the authority that is necessary for their acceptance.

The trouble in medicine does not lie with the statistical method but with the medical men who do not know how to use it. I regret to state that I belong to this class and have felt keenly that in medical school I did not have an opportunity to attend a course on medical statistics. The day will come, gentlemen, when such courses will be given, when

the law of probability will help in diagnosis, when the coefficient of co-relation, now explained by most authorities in such terms that in a few minutes my idea of my relation to my surroundings has become totally insufficient,—when, I say, all these things will be understood by the medical graduate. At that time medical men will cease to do such foolish things with statistics as to try to add cabbages and cows or, what is nearly as bad, to try to solve problems in heredity by finding how many parents had the disease from which the offspring suffers without due respect to many other very important and possibly contradictory details. What would you think of a bookkeeper who after years of personal experience would gather up the bills in the cash drawer and go to the bank with the statement that his personal experience led him to believe that the roll of bills amounts to $1000. The receiving teller would quickly apply the statistical method and few would venture to side with the bookkeeper, no matter how large his experience had been.

Do not misunderstand me. This is not an argument in favor of dry statistical articles which we all prefer to avoid reading. But if I can make you see how important it is for us to cease using the pet phrase "my personal experience" except when we have sufficient data to support it, I shall have accomplished what I had hoped for.

From these premises I should like finally to draw the following conclusions:

1. *Our fitness alone renders our observations of value.* By fitness I mean honesty, carefulness, and willingness to record our observations, no matter how many cherished theories they overthrow.

2. A few carefully observed and recorded cases greatly outweigh a large number of cases stored in a memory, however tenacious.

3. Personal experience should be based upon carefully studied statistics of personal observation and not upon personal impressions, which often cover all lack of recorded observation and, in my opinion, avail only for diagnosis.

4. We should not use the phrase "personal experience" as a cloak to cover our ignorance of our real personal experience.

THE INFLUENCE OF SMALLPOX AND VACCINATION ON PULMONARY TUBERCULOSIS

HORACE JOHN HOWK AND WILLIAM E. LAWSON

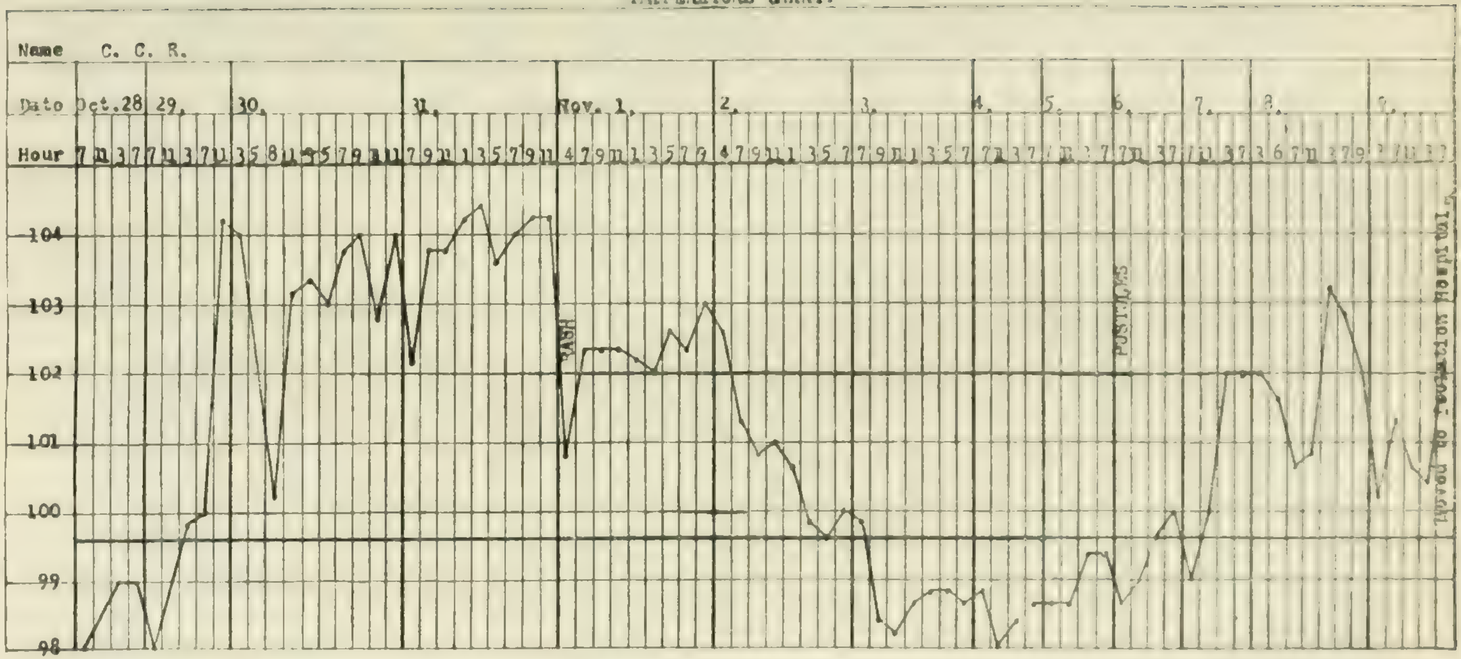
Mt. McGregor, New York

This report is a record of an epidemic of smallpox occurring in the Metropolitan Life Insurance Company Sanatorium in the autumn of 1914. Time has purposely been allowed to intervene between the epidemic and the writing of a formal record of it in order that our observations might show, not alone the immediate effects, but some of the more remote influences of smallpox on pulmonary tuberculosis as well.

Happily, or unhappily, as one chooses, there have been few similar experiences reported in any available literature, nor is more than brief mention made in any of the writings on exanthematous diseases of the possible or probable effect that smallpox may have on clinical tuberculosis, although the literature is quite replete with reports of certain other concurrent complications of pulmonary tuberculosis.

On October 15, 1914, a patient coming from Alabama was admitted to the sanatorium with tuberculosis, bacilli having been demonstrated in the sputum. Our initial examination confirmed this diagnosis and placed his disease in the moderately advanced class. A history of recent severe chills and fever, and his residence in a country in which malaria is prevalent, led to repeated examinations of the blood, in which tertian parasites were found. The established routine was followed of placing the patient in a single room for observation and diagnosis. He was allowed to go to the bath room, since his temperature remained below 99.2° (rectal) and his pulse within normal limits. His observation period was entirely uneventful and on October 28 (the thirteenth day after admission) he was transferred to a ward with several other male patients. On the evening of October 29 his temperature reached 100° and at midnight 104.2.° The fever was preceded by a hard chill and immediately followed by nausea, vomiting, looseness of the bowels, and lumbar backache. The temperature (see chart) quickly dropped to 100.2° during the early morning of the thirtieth and promptly rose again to above 103° and remained at about that level for two days, then falling gradually to subnormal, where it continued until a secondary rise began on November 7. To add to the

TEMPERATURE CHART.



confusion during the first three days of fever malaria parasites were persistent in the blood, thus giving in one individual three fever-producing diseases, any one of which might be responsible for his acute illness. Quinine medication was given following the initial rise in temperature. The diarrhoea increased to eight liquid movements on November 1, but decreased steadily thereafter. On the morning of November 1 a distinct and characteristic rash had appeared on the forehead, face and forearms, which by November 6 had spread over the extremities and trunk in a characteristic way and was becoming pustular. The patient was again isolated immediately with the onset of the initial fever and remained in isolation throughout the remaining course of his disease. He had a moderately severe discrete smallpox with good recovery and returned to the sanatorium from the Saratoga Springs Isolation Hospital, which was kindly lent to us, on December 17. He had never been vaccinated, although he lived in a community in which smallpox was practically endemic among the mill workers.

Upon the full recognition of the nature of the infection all known contacts were vaccinated. But exposure had already occurred, resulting in the development of six other cases among the tuberculous patients.

C. E., came to Mt. McGregor November 4, 1914, with moderately advanced pulmonary tuberculosis. His treatment was uneventful until November 15 when his temperature began to rise, reaching 102.2° on the sixteenth (with headache, vomiting and backache), followed by the typical drop seen in mild cases, to be succeeded by a secondary rise with the development of pustules. He was treated in the isolation hospital and returned December 29. This patient reports having been vaccinated in 1898, in 1904 and again in 1909. He stated that all three vaccinations were successful but we found no scars resulting therefrom.

S. R., entered the sanatorium on November 2, 1914, with incipient pulmonary tuberculosis, and was progressing normally until November 19, when he complained of headache, lumbar backache, nausea and vomiting. His temperature reached 102.6° on the nineteenth, going to 103.8° on the twentieth, followed on the twenty-second by a rash on forehead and back. He was removed to the isolation hospital where he ran a mild discrete course of smallpox with characteristic eruption and fever. This patient had never been vaccinated.

W. E. B., entered the sanatorium May 25, 1914, with moderately advanced pulmonary tuberculosis. He developed sudden fever, vomiting, diarrhoea and lumbar backache on November 19, 1914. The rash followed on the twenty-third. He remained in the isolation hospital until December 24. His disease was of the discrete type and moderately severe. He reported a successful vaccination in childhood and had a small scar on his left arm.

B. B., with moderately advanced pulmonary tuberculosis, had chills, nausea, vomiting, headache and backache on November 18, a rising temperature on November 19 reaching 104.6° on the twentieth. At noon of the twenty-second a rash appeared over her entire body, followed by a drop in temperature, and on the eighth day by a development of pustules and secondary rise in temperature. She was removed to the isolation hospital November 24 and returned, recovered, December 24, 1914.

This patient had been in the sanatorium more than eight months when she contracted smallpox. She was acutely ill on admission and was confined constantly to bed during the first few weeks, after which, for a month, she was able to sit up while her bed was made. She again became continuously ill and for six months prior to the epidemic had not been out of her bed once. Much doubt was expressed as to whether she could stand the ambulance trip to the isolation hospital. She had never been vaccinated.

F. B., having moderately advanced pulmonary tuberculosis, on November 20, 1914, complained of severe chills, headache and backache. His temperature reached 103.8° on the twentieth and ranged from 102° to 105° until the twenty-second, when it dropped to 100.6° with the appearance of the rash on forehead and forearms, and continued slightly above normal until the development of the pustules. His smallpox was of the mild discrete form. He had had his last successful vaccination when four years old but had no scar.

W. G. B., with incipient pulmonary tuberculosis, on November 23 had a severe chill followed by headache and backache. His temperature rose to 103.2°. On the twenty-fifth it reached 105.2° and subsided to normal on the twenty-sixth with the appearance of rash on forehead, arms, body and legs on the same day. He was promptly isolated and ran a severe course of smallpox. He had never been vaccinated. Dr. Towne, who cared for these patients while they were isolated, reported that some of the lesions in this case became confluent.

TUBERCULOSIS AS AFFECTED BY SMALLPOX

There were seven cases of pulmonary tuberculosis which contracted smallpox, all of which recovered. In one case there was a moderately severe bronchitis following the onset of smallpox. There was no development of pneumonia in any case. The smallpox was of a mild form in six cases, severe in one, and its course was apparently unaffected by the presence of tuberculosis. The one outstanding feature of the tuberculosis following smallpox was the marked diminution of expectoration in two advanced, active cases. The effect was more striking than anything we have witnessed in tuberculosis, except the reduction following arti-

Table showing the influence of smallpox on tuberculosis

Tuberculosis before smallpox								Smallpox			Tuberculosis after smallpox					
Case number	Age	Duration	Activity	Extent: Class	Extent: Turban	T. B. Bac.	Sputum daily	Onset	Type severity	Result	Râles	Cough	Sputum	T. B. Bac.	Activity	Present condition
							grams									
C. C. R. 118	29	6 yrs.	Yes	M. A.	II L. I. R. II	Yes	5–20	1914 Oct. 29	Discrete mod. severe	Recovered	Unchanged	Decreased	Decreased	No	No	M. A. Quiescent
C. E. 124	27	1 yr.	No	M. A.	II L. I R. II	No	5–30	1914 Nov. 15	Discrete mild	Recovered	Diminished	Unchanged	Increase followed by decrease	No	No	Well and working. Bac. found
S. R. 123	26	1 yr.	No	Inc.	I L. I. R. I.	No	Scanty	1914 Nov. 19	Discrete mild	Recovered	Diminished	Decreased	None	No	No	Well and working 4½ yrs.
W. B. 74	37	1 yr.	Yes	M. A.	III L. I R. III	Yes	30	1914 Nov. 19	Discrete mod. severe	Recovered	Diminished	Decreased	None for 4 months	After 4 mos.	No	Died Nov. 1919
B. B. 56	33	4 mos.	Yes	M. A.	III L. II R. III	Yes	130	1914 Nov. 18	Discrete mild	Recovered	Diminished	No	No	No	No	Well and working 2½ yrs.
F. B. 81	22	4 yrs.	Yes	M. A.	I L. I. R. I	Yes	10	1914 Nov. 20	Discrete mild	Recovered	Unchanged	Unchanged	Unchanged	Yes	No	Well and working 2½ yrs.
W. G. B. 119	35	2 mos.	No	Inc.	I L. O R. I.	No	None	1914 Nov. 23	Discrete severe	Recovered	None	No	No	No	No	Well and working 3½ yrs.

Note: Activity here means clinical activity with presence of primary symptoms of tuberculosis.

ficial pneumothorax. In one case (no. 56) there has never been any return of sputum or bacilli, although she had extensive basal lesions. In the other the sputum and bacilli were absent for four months.

In two other moderately advanced cases the diminution of sputum was quite definite after smallpox and in one bacilli disappeared from the sputum. There was no evident change in the other case. The three remaining cases were not definitely active in our judgment. They were progressing favorably when they contracted smallpox and continued convalescence without interruption. Their progress seemed neither faster now slower than other similar cases who escaped smallpox.

The preceding table opposite shows in detail the changes noted in tuberculosis as affected by smallpox.

VACCINATION

Three of the seven cases of smallpox lived in the same ward with the patient who brought the original infection. None of them had ever been successfully vaccinated and two had never been vaccinated. Two other smallpox cases were in separate rooms but used the bath room with the original case. One had been unsuccessfully vaccinated before; the other had a small scar from childhood vaccination. The seventh case had been so isolated in a single room because of her acute tuberculosis that we are unable to account for the infection. She had never been vaccinated.

Of the other eight occupying the ward, none of whom contracted smallpox, seven had good vaccination scars from ten to thirty years old. There is no record of previous vaccination in the other case.

Vaccination was made of all patients and employees of the sanatorium upon recognition of the nature of the infection, and for several subsequent months all newly admitted cases which did not show a good scar were vaccinated. Vaccine was obtained from the State Department of Health and the operation made by means of incision in the skin over the insertion of the deltoid muscle.

Ambulant patients were advised to remain quiet during the incubation period and observations were made of the vesicles to determine that reactions were characteristic.

Altogether 178 patients in all stages of tuberculosis were vaccinated, 143 of which took successfully and 45 (25 per cent) had general reactions, characterized by fever, prostration, nausea, vomiting, diarrhoea and backache. Twenty-eight per cent of the general reactions were quite severe, with fever of 105° or over.

There was no demonstrable relation between the severity of the reaction and the extent or activity of the tuberculosis; neither condition seemed to be affected by the other. By comparison with the vaccinia of healthy employees who were vaccinated at the same time, there were no differences that we could appreciate. Vaccinations were repeated in unsuccessful cases.

The following table shows the number of cases vaccinated in the different stages of tuberculosis, the number of reactions, and the number in whom there was an increase in extent or activity of the tuberculosis following vaccination.

		EFFECT OF VACCINATION	COURSE OF DISEASE—IMMEDIATE
178 tuberculous cases vaccinated	49 incipient	38 successful (5 severe vaccinia)	36 unchanged (5 severe vaccinia) 2 increased
		11 unsuccessful	10 unchanged 1 increased
	111 moderately advanced	90 successful (33 severe vaccinia)	85 unchanged (31 severe vaccinia) 5 increased (2 severe vaccinia)
		21 unsuccessful	20 unchanged 1 increased
	18 far advanced	15 successful (7 severe vaccinia)	4 unchanged (4 severe vaccinia) 11 increased (3 severe vaccinia)
		3 unsuccessful	1 unchanged 2 increased

Note: Severe reactions were in all instances typical vaccinias, characterized by fever, head and backache, nausea, diarrhoea, etc.

CONCLUSIONS

1. Smallpox, occurring in patients with pulmonary tuberculosis, runs a course not noticeably different from that encountered in well people. The symptomatology, appearances of exanthem, and duration of the smallpox, are not influenced by the presence of tuberculosis.

2. In early, inactive cases of tuberculosis with favorable prognosis there is no apparent interruption of recovery when complicated by smallpox.

3. In one active advanced case there was a disappearance of sputum and bacilli after smallpox, lasting for four months.

4. In one very active advanced case there was a permanent disappearance of sputum and bacilli immediately after the smallpox. The disease was progressive up to the time of smallpox and retrogressive thereafter.

5. The seven recovered from smallpox and six are alive and well at present.

6. The presence of tuberculosis does not affect the normal course of vaccinia. Tuberculosis in any stage or any degree of activity was not affected by vaccination, either favorably or unfavorably.

We would express grateful appreciation to the State Department of Health for their timely assistance at the time of the epidemic, and to Dr. G. Scott Towne for his painstaking care of the patients during their smallpox.

DETAILED RECORDS OF SEVEN CASES OF TUBERCULOSIS COMPLICATED BY SMALLPOX

C. C. R. Case no. 118. Age twenty-nine. Earliest definite history of tuberculosis, 1908.

Examination, October 17, 1914: Right lung, moderate dulness above clavicle; impaired resonance from clavicle to 2nd i. c. s.; m. c. râles heard throughout this area. Posteriorly: Moderate dulness to 4th v. s. with numerous m. c. râles. Left lung, impaired resonance to first rib with f. c. râles.

X-ray: Right, moderately dense shadow composed of interweaving bands and strings extending out from hilum, filling circle of first rib and 1st and 2nd interspaces. Left, definite shadow in circle of first rib composed of interweaving bands.

Complication, malarial fever.

Sputum October 31, 1914, positive Gaffky vii; 25 grams per day. With onset of smallpox, October 29, 1914, there was a moderate increase in expectoration, accompanied by bronchitis, maximum sputum reaching 60 grams on November 6. Upon return of the patient from isolation hospital the sputum averaged 5 grams for one month and then disappeared until June, 1915, when he had from a scant expectoration to 15 grams daily. Bacilli were never demonstrable after the smallpox.

Physical examinations made immediately after recovery from smallpox demonstrated practically the same signs as before. There was no apparent extension of the tuberculosis.

Patient was discharged May 10, 1916, with his disease quiescent. Fine râles were demonstrable at the apex of the right lung anteriorly and posteriorly.

Patient readmitted to sanatorium May 27, 1918, complaining of cough, which had started in December, 1917, followed by expectoration, chills and fever, and loss of weight. He had lost 33 pounds since leaving the sanatorium.

Examination May 30, 1918: Right lung showed moderate density down to 4th rib, and less marked density throughout remainder of lung; numerous m. c. râles throughout this area. Posteriorly: Practically same as front. Left lung, definite impairment of resonance

to lower border of 3rd rib, with numerous m. c. râles throughout this area. Posteriorly: Resonance impaired over upper lobe without râles.

X-ray, diffuse mottled shadows throughout entire lung, increasing in density to apex. Left, stringy beaded shadows in circle and first interspace, and mottled shadows in 2nd interspace.

There was a marked extension of his tuberculosis in both lungs and it was very active.

Sputum positive, Gaffky v; weight 5 to 20 grams daily.

Malaria demonstrable in blood; had chills and fever in August, 1918.

Pleural effusion April, 1919 (1).

Present condition: Patient about to be discharged from sanatorium with disease quiescent. Has gained 49 pounds; sputum negative since September, 1918.

C. E. Case no. 124. Age twenty-seven. Earliest definite history of tuberculosis, one year before admission.

Present illness began in January, 1914, with cough and expectoration; no record of cold or grippe; had blood in sputum in May, 1914; languor marked; marked loss of weight and strength; fever and night sweats in December, 1913. "Pneumonia" at ten.

Examination November 13, 1914: Right, impaired resonance at apex with f. c. râles down to 2nd v. s.; definite friction rub at base. Left, impaired resonance to 2nd rib with m. c. râles above and below clavicle. Posteriorly: f. c. râles to 2nd v. s.; friction rub at base anteriorly.

X-ray: Right, definite shadow in circle of first rib; left, shadow in circle of first rib and first interspace, radiating out from hilum.

No complications.

Sputum on admission ran from 5 to 30 grams a day. His smallpox began November 15, 1914. On his return from isolation hospital his sputum was 70 grams per day at one weighing, 30 at another, but in a month had stopped altogether. Bacilli were not found.

The apical râles heard on admission had disappeared after his smallpox and did not recur at any of the subsequent monthly examinations.

Patient discharged July 1, 1915. Resumed work as insurance agent.

Readmitted to sanatorium October 21, 1915. After working seven weeks lost strength and 9 pounds in weight; temperature reported as 101° rectal; cough and expectoration absent.

Examination October 27, 1915: Definite impairment of resonance at both apices without râles; coarse friction rub over entire left base.

On February 28, 1916, bacilli (Gaffky ii) found in mucoid expectoration.

Discharged August 31, 1916; disease quiescent.

Patient readmitted July 25, 1917, complaining of loss of 10 pounds in weight. Physical and X-ray examinations on admission were the same as on last admission. No expectoration. He was discharged October 11, 1917, and subsequently left the company's service. His annual reports show that he has been working in a drop forge plant for two years and has remained well. He recently visited the sanatorium and seemed as well as when last discharged.

S. R. Case no. 123. Age twenty-six. Earliest definite symptoms of tuberculosis, one year before admission. Onset with loss of weight, cough, languor, subnormal morning temperature, pulse 90.

Examination November 13, 1914: Right, impaired resonance to 3rd rib; few m. c. râles from apex to 2nd rib. Posteriorly: Impaired resonance to 3rd v. s. with f. c. râles over upper lobe. Left, slight impairment of resonance at apex without râles.

X-ray showed stringy shadows at apices of both lungs.

No complications.

Bacilli not found. (No expectoration.) Patient made uneventful recovery following smallpox, which started on November 19, 1914.

The medium and fine crepitant râles heard at the right apex on admission were no more heard immediately after recovery from smallpox and on monthly examinations.

Annual reports on condition since discharge state that he has kept well ever since leaving the sanatorium.

W. E. B. Case no. 74. Age thirty-seven. Earliest definite symptoms of tuberculosis, one year before admission, beginning with "bronchopneumonia."

Examination October 22, 1914: Right, dulness to 2nd rib, moderate dulness to 4th rib; m. c. râles from apex to 4th rib. Posteriorly: Dulness to 4th v. s.; coarse crepitant râles to 5th v. s.; moderate superficial dulness throughout remainder of lung. Left, impaired resonance to 4th rib with m. c. râles above and below clavicle. Posteriorly: Fine crepitant râles down to 3rd v. s.

X-ray: Right, marked contraction of upper portion of right thorax with dense stringy and band-like shadows throughout upper two-thirds of lung. Left, scattered mottled and beaded shadows down to 4th rib.

Complication: Otitis media (tuberculous).

Sputum on admission, Gaffky vii. Examination immediately before smallpox negative; all subsequent examinations positive. Average sputum weight before smallpox 30 grams per day. Immediately after smallpox average 7 grams for one month. For succeeding four months no expectoration. Rapid increase from then on, with continuously high sputum weight.

Examinations after recovery from smallpox showed no change in extent or character of râles in right upper lobe. The crepitant râles at the left apex had disappeared and were not heard again for three months, after which they were heard at every examination and gradually extended over the entire lung.

In November, 1918, patient contracted influenza while away on visit, soon after which the activity of his disease increased and he slowly lost ground to the time of his death, November 14, 1919.

B. B. Case no. 56. Age thirty-three. Earliest definite symptom of tuberculosis, November, 1913. Began following tonsillectomy; early symptom severe pleurisy. Taken to Flower Hospital, N. Y., December 3, 1913; remained there until admitted to sanatorium. Following pleurisy was told that pneumonia developed and, on December 19, that she had gangrene of the lung. Correspondence in January, 1914, shows she was severely prostrated and in March it was reported that a "tubercular process" at the base of the right lung had developed. Tubercle bacilli not found.

Examination November 17, 1914: Right front, moderately dull percussion note at apex, with m. and f. c. râles to 2nd rib; marked impairment of resonance from upper border 4th rib to base, with coarse crepitant râles. Right back, m. c. râles to 3rd i. s.; moderate dulness below 6th rib with numerous m. c. râles. Left front, impaired resonance down to 2nd rib, with few scattered fine râles. Left back, few fine râles at apex with scattered m. c. râles below 7th v. s.

X-ray: Definite densities at apices of both lungs and rather uniformly hazy shadows below 3rd rib in right lung, and the 4th rib in the left. These shadows filled entire lower portions of the lungs.

Sputum on admission averaged 45 grams per day. In May and June, 1914, it increased markedly, reaching high peaks of 530 and 625 grams of purulent offensive sputum. In July the average was 239 grams per day; August 222; September 188; October 144; November, to beginning of smallpox, 130.

Her smallpox started November 19, 1914. She returned to the sanatorium December 24th; her expectoration was scant (less than 10 grams a day) to January 16th, after which she had none up to the time of her discharge, October 14, 1917. Sputum, Gaffky v on admission; Gaffky iv on October 31, last examination before smallpox. Bacilli were never found afterward.

Complications during residence, before smallpox, repeated hemoptyses during acute course of tuberculosis, and an ischiorectal abscess.

Patient weighed 46 kgm. on admission and gained 1300 grams during the first two weeks. She then became acutely ill with tuberculosis and was not weighed until after the smallpox, when she weighed 48.9 kgm. During the intervening months of her critical illness it was apparent that she had lost a great deal of weight. The condition became so critical shortly before her smallpox that death seemed only a matter of a few days. Her gain after the smallpox was rapid, reaching 64 kgm. in June, 1915, which point she maintained throughout the remainder of her residence.

The medium and fine crepitant râles at the right apex and fine râles at left apex, heard at all examinations before the smallpox, were not heard at any monthly examination after the acute disease. The m. c. râles heard over the right lower lobe persisted throughout her residence; those over left lower lobe gradually cleared and were last heard April, 1915.

Present condition: After her formal discharge from the Sanatorium in October, 1917, patient worked here for some time as telephone operator. She then took a similar position in New York City and her recent annual report shows that she has been constantly well since leaving here: she has no cough or expectoration, maintains her weight well above normal and has been married during the past year.

F. B. Case no. 81. Age twenty-two. Earliest symptom of tuberculosis, August, 1910, when he took treatment at Loomis Sanatorium.

Examination November 17, 1914: Right, resonance impaired at apex, without râles. Posteriorly, impaired resonance to 3rd v. s. without râles. Left, impairment of resonance at apex without râles. Posteriorly, impaired resonance at apex.

X-ray: Right, gave a definite filmy shadow filling circle of first rib. Left, dense interweaving striations running from hilum to circle of first rib and first interspace.

No complications.

Patient had smallpox during latter part of November and early December, 1914. Examination January 12, 1915, gave the same signs as examination November 17, 1914, and there was no change from month to month thereafter until discharge, July 30, 1915.

Sputum averaged 10 grams a day prior to smallpox and about 8 grams per day after and during remainder of residence. Bacilli found before and after smallpox.

Patient readmitted June 18, 1917. On May 11 preceding he had had an hemoptysis of about a cupful of blood.

Examination showed moderately dense disease in the upper fourth of both lungs, with some contraction of right apex.

X-ray showed considerable pulling of mediastinum and trachea to right, and definite beaded, stringy shadows down to 2nd rib on right and 3rd rib on left.

Tubercle bacilli (Gaffky ii) were found.

He remained under treatment until November 24, 1917.

Present condition: Patient reports that he is as well as when he left the sanatorium and works steadily.

W. G. B. Case no. 119. Age thirty-five. Earliest definite history of tuberculosis August, 1914.

Admitted October 16, 1914.

Examination October 19, 1914, showed possible impairment at both apices without demonstrable râles.

X-ray showed filmy, not wholly characteristic, shadows in circles of first ribs.

No complications.

No expectoration.

Gained steadily from admission to onset of smallpox, November 23, and continued his gain after the acute infection at apparently the same rate as before. Examinations made subsequent to smallpox revealed no changes in physical signs.

He was discharged April 30, 1915. Readmitted to the sanatorium August 26, 1915, because of loss of 12 pounds in weight, without other definite symptoms. Remained in the sanatorium until September 28, 1916. On monthly examinations during this period râles were found at right apex on 8 examinations and at left apex on 4. Pleural rubs were always present at both bases. He had slight mucoid expectoration at times. Bacilli were never demonstrable. Recovery was uneventful.

Present condition: States that he is not as well as when he left the sanatorium; that he has pleurisy and has lost 16 pounds.

REFERENCE

(1) Howe, H. J., and Herring, J. A.: An uncommon case of pleural effusion. Amer. Rev. Tuberc., 1919, iii, 585.

SOME PROBLEMS IN THE DIFFERENTIAL DIAGNOSIS OF PULMONARY TUBERCULOSIS

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In presenting the subject of differential diagnosis of certain conditions often confused with pulmonary tuberculosis, I wish to excuse myself on the ground that, in the very numerous discussions of the diagnosis of chest conditions, an almost unanimous emphasis has been placed upon the frequency of unrecognized tuberculosis. This situation is only too familiar to all of us; and, although improving, it is still bad enough to remain a reproach to the medical profession to far too great an extent.

It is far from my desire that anything that I may say should be interpreted as in any way an argument against every effort to promote the early recognition of tuberculosis. This is, and should be, the prime consideration of the antituberculosis movement as it relates to the medical profession.

The physicians in this conference, however, do not, I consider, need this emphasis. You represent the best of America's experts in the diagnosis and treatment of tuberculosis and I therefore venture to present to you the problem with the emphasis reversed, that is, upon the danger, perhaps especially great, among experts in tuberculosis, that tuberculosis may be not infrequently diagnosed when it does not exist.

Speaking broadly, such diagnosis of dubious or uncertain cases has probably been to the advantage of the greater number of patients; for certainly much less harm is done even in cases of mistake than where cases of actual tuberculosis are overlooked. One cannot, however, escape dissatisfaction with inexact medical diagnosis, to say nothing of the hardship and injustice which are inflicted upon unfortunate individuals, needlessly branded with the stamp of a dreaded disease.

It is the experience of many institutions for the treatment of tuberculosis that a large percentage of the cases admitted are not tuberculosis; in my tuberculosis service at Bellevue Hospital it is as high as 20 per cent, and I take it as extremely probable that a similar situation exists elsewhere.

The study of these cases furnishes one of the most interesting fields for the specialist in pulmonary tuberculosis, and also affords a backgound of knowledge of other chest diseases and of general internal medicine which is much needed if we are to be really skilled diagnosticians and to practise with satisfaction to ourselves and to our patients.

From the large field of possibilities we may select for consideration a few groups, with which I myself have had difficulty. In many of these cases the diagnosis of tuberculosis is undoubtedly quite properly established; in many others, however, other explanations of the signs and symptoms are forthcoming, and the obvious but erroneous diagnoses of tuberculous disease may be consequently and satisfactorily avoided.

The conditions which will here be considered may be divided into two main groups:

1. Those in which the history and symptoms are suspicious of tuberculosis, but the local lesion is slight and difficult to find. A problem in physical diagnosis.

2. Those presenting very definite physical signs in the lungs. A problem of interpretation.

1. THOSE IN WHICH SUSPICIOUS SYMPTOMS PREDOMINATE

General asthenia. A not inconsiderable number of people, more often women or children, are constitutionally frail. They have little strength or endurance, are below average weight and are apt to present, at intervals, irregular symptoms, such as nervousness, irritability, indigestion, headache without ascribable cause, etc. Such cases often simulate tuberculosis, especially when subject to recurrent colds and other infections, as they often are. Prolonged observation and frequent examinations are needed to establish a definite conclusion. Tuberculin tests are of value, especially in children and adolescents; and many, but by no means all of the group, may eventually be demonstrated as tuberculous.

If proper supervision and general management of their mode of living are established, the physician is safeguarded from unfortunate results from delaying a positive diagnosis, and most gratifying improvement or complete restoration to health and vigor may often be expected. Physicians owe these cases a systematic care and oversight which, on account of the indefinite and unsatisfactory nature of their symptoms, they are frequently not given.

Neurasthenia. This group is quite similar to the last, with, however, a predominance of nervous symptoms, often to the point of a real psychoneurosis. They are often the despair of physicians, both from the standpoint of diagnosis and of treatment. They may be tuberculous and the nervous symptoms may be an expression of the toxaemia: more frequently, however, they are not. One frequent source of error is the fact that regular or irregular elevations of temperature often occur, probably due to disturbances of the sympathetic nervous system.

The increasingly general and commendable practice of regular temperature observations in suspected cases increases this possibility of mistake, unless this fact is born in mind. In women the normal premenstrual rise of temperature is especially apt to be accentuated or prolonged in these cases.

As in the preceding group, prolonged observation coupled with a regular regimen of life, not only furnishes the sole means of correct diagnosis, but also meets the proper indications for treatment, whether or not tuberculosis is eventually found to be present.

Hyperthyroidism and other disturbances of internal secretions. These patients complain of malaise, loss of weight, general nervousness, digestive disturbances and sometimes a chronic unproductive cough, when the thyroid is enlarged. On examination they are found to be poorly nourished, have a rapid pulse, are easily fatigued and, possibly the most frequent source of error, usually have a slight elevation of temperature in the afternoon which is accentuated by exertion or excitement.

The general examination of the patient, so often slighted by the specialist in pulmonary disease, discloses the fine tremor of the hands, the tachycardia, the slight enlargement of the thyroid, the exaggerated tendon reflexes and possibly exophthalmos, upon which the correct diagnosis of hyperthyroidism rests. The Goetsch test (the hypodermic injection of adrenalin) usually gives a distinct constitutional reaction and appears to be of real value in diagnosis.

In other cases, hypothyroidism exists, or there are general symptoms of nervousness and disturbed nutrition, apparently associated with abnormal function of the ovarian or adrenal internal secretions. Proper observation and supervision of the regimen of life continued with the administration of extracts of animal glands of internal secretion or, sometimes in hyperthyroidism, with surgical operation upon the thyroid, frequently result in satisfactory results, as well as the establishment of a clear diagnosis.

Chlorosis. Primary anaemia, especially in young girls, is accompanied with general symptoms which simulate tuberculosis. It must be borne in mind that tuberculosis often develops during such a condition and also that a secondary anaemia, due to tuberculosis, may closely simulate chlorosis. This constitutes one of the many neglected problems of adolescence.

Study of the blood characteristics, proper regimen, especially of rest and diet, combined with close supervision, including frequent painstaking examinations of the chest, usually clarify the diagnosis.

Fevers of obscure origin. Fever constitutes the chief early manifestation of many conditions of which the focal and pathognomonic signs or symptoms are often slow in developing.

Pulmonary tuberculosis is one of the most frequent of these; but there are many others, and errors of diagnosis in both directions are unfortunately frequent. An appreciation of the chief possible causes of such fever is essential; hasty diagnosis is to be avoided; and close observation with close watch for the development of some definite and characteristic evidence is often needed. It must be remembered that fever from whatever cause is associated with certain other symptoms, such as malaise, recurrent sweats, headache, loss of appetite and other digestive disturbances, loss of weight, etc., which do not in themselves furnish the clue to a correct diagnosis. Several more common febrile conditions may receive more specific consideration, as for example:

a. Typhoid and paratyphoid fever. A week or ten days often elapses before definite signs other than fever manifest themselves in these diseases. Persistent frontal headache, epistaxis, an enlargement of the spleen, continued fever without marked morning remissions, and, later, a tendency to tympanites, the appearance of rose spots and the development of a positive blood culture and Widal reaction, make up the more usual sequence of events.

When associated with bronchitis and its accompanying cough the early differential diagnosis is not easy. The signs in the chest, however, are usually not definitely localized, are bilateral at the bases and are apt to be variable in location and extent.

The active febrile stage of early pulmonary tuberculosis is very likely to subside in two or three weeks when the patient is at rest in bed. If the signs in the chest are obscure or overlooked, such cases are frequently called mild typhoid fever. No such case of fever should be so lightly dismissed unless definite evidence, such as a positive blood reaction or

culture, or very definite rose spots and enlarged spleen are present. Repeated examination of the chest and of the sputum, and X-ray examination after the patient is able to be up and about frequently lead to the correct diagnosis.

b. Malaria. The differential diagnosis here is not difficult and consequently errors have little excuse. Nevertheless, it is true that many cases of tuberculosis are diagnosed and treated as malaria until the case is advanced and the golden opportunity for successful treatment has passed. This fact can only be explained by superficial study and examination and an easy-going tendency to use the term "malaria" as a catchbasket diagnosis for unexplained fevers, accompanied by rather indefinite symptoms. This lack of appreciation that malaria is a very definite clinical entity, caused only by the infecting plasmodium which can usually be detected in the blood with at most slight difficulty, is widespread enough to cast considerable discredit upon the medical profession. Unrecognized and neglected tuberculosis is one of the most frequent results.

c. Influenza. Side by side with malaria stands "grippe," as the ready answer of the careless practitioner to the demand for a labeling diagnosis of a mild febrile attack. That this is more likely than not to be erroneous does not appear to have lessened the frequency of the habit. This is possibly because the real truth is never ascertained and the patient recovers from whatever the transient infection may have been. Certain influenza lesions in the chest present real difficulties in differential diagnosis which will be especially considered later, but in the main the error is made in the opposite direction and it is the early localized tuberculosis which is overlooked, when careful search for signs, combined with sputum and X-ray examination, would easily clear up any doubt. Continued observation and study of all patients who cough, until the cough is satisfactorily explained, would avoid many mistakes. When accompanied by fever the responsibility for such careful study is imperative.

d. Focal infection. This is a very interesting and difficult group of conditions, much studied of late, but still far from perfectly understood.

When associated with fever and mild constitutional reaction and with chest pains or sometimes cough, the differentiation from obscure tuberculous lesions is far from easy.

The most frequent locations of such foci are the teeth, the tonsils, the upper air passages, especially the accompanying nasal sinuses, the intestines and the genitourinary tract. Arrival at a satisfactory diagnosis is often a tedious affair and frequently a matter of a gradual elimination of various possibilities. The late realization that pulmonary tuberculosis was the real offender during all the weeks consumed in treating or removing teeth or tonsils, or other surgical operations, or in elaborate procedures aimed at intestinal autointoxication, is not an enjoyable experience for either physician or patient. On the other hand, irregular fevers are often caused by just such focal infections, the removal of which brings brilliant results. In this difficult field only painstaking search will reveal the true situation.

e. Septic endocarditis. This condition is frequently the result of a focal infection not always discoverable. In itself, however, it is frequently overlooked and mistaken for tuberculosis. The murmurs of valvular disease, the irregular temperature with or without chills, the *petechiae*, the enlarged spleen, the discovery of a likely source of focal infection, the frequent polynuclear leucocytosis and finally the positive blood culture, are the main evidences upon which the diagnosis rests. The condition is undoubtedly much more common than is usually recognized and its diagnosis is frequently overlooked.

In this whole group of cases exhibiting indefinite constitutional symptoms the suspicion of possible tuberculosis should always be entertained because of its overwhelming frequency. With this attitude of mind, fortified by care and patience in the search for direct evidence, the correct solution of these interesting problems can usually be obtained.

2. CASES PRESENTING PHYSICAL SIGNS IN THE LUNGS, A PROBLEM OF INTERPRETATION

Tuberculous infection vs. tuberculous disease. It is to be noted that in the problems of differential diagnosis thus far considered the difficulty lies with the proper interpretation of general symptoms, and that suitable regimen during the period of observation meets the main indication for treatment, thus affording opportunity for study and diagnosis without jeopardizing the interests of the patient, whatever the final diagnosis may be.

A far greater difficulty arises when, in addition, slight deviations from the normal are revealed by careful physical examination of the lungs.

The point to be emphasized is that infection with tuberculosis may produce slight lesions which are permanently recognizable by careful clinical methods. The physical signs of such lesions may or may not have any clinical significance. Their correct interpretation is only possible in the light of corroborative evidence from the subjective and constitutional symptoms. Given signs, such as slight impairment of resonance, slight alteration in the breath sounds or fine crackling râles, without stickiness or moisture at a pulmonary apex, the presumption of an inactive fibroid lesion is justified unless constitutional evidence of active disease is present. The determination requires time, care and repeated observation of the usual clinical phenomena such as temperature, pulse rate, fatigue, digestion, nutrition, etc.; but the diagnosis of active clinical tuberculosis demanding treatment is not justified upon such physical signs alone.

In these days of required periodic physical examinations for the apparently well, so frequently and quite properly becoming a part of organized business and industry, as well as requirements for life and health insurance, the recognition and correct interpretation of the physical signs of old tuberculous infection, as distinct from active disease, assume increasingly great importance.

Conditions presenting marked physical signs. The problems in this group are in the main more difficult than in the preceding; mistakes are consequently less reprehensible even if more frequent. In doubtful cases the general practitioner would do well to ask early expert advice from those who have had an opportunity to study pulmonary disease upon an extended scale. The mistake here is usually that of making a positive diagnosis of a tuberculosis which does not exist.

In general, the physical signs are marked, often extensive and accompanied by considerable cough and expectoration. In all such cases persistently negative results in the examination of the sputum for tubercle bacilli should arouse the suspicion that a nontuberculous lesion exists. *Extensive pulmonary tuberculosis with persistently negative sputum is very rare.*

In this group the X-ray is also of the greatest value, giving information often unobtainable by physical examination and frequently establishing a certain diagnosis. This means of examination should never be neglected.

a. Emphysema and chronic bronchitis. This very common condition is frequently confused with pulmonary tuberculosis. While the diagnosis is not always easy, the mistake can usually be avoided by care.

The history of chronic cough, usually with marked expectoration, shows a distinct tendency to exacerbation during the winter months. Asthma is frequent and the chronic dyspnoea is associated with the physical signs of emphysema. The sputum, though profuse, is negative for tubercle bacilli and the râles in the chest indicative of bronchitis are bilateral, widely distributed and with marked tendency to predominance at the bases, and vary greatly in number and location from day to day.

Tuberculosis is often associated with, or develops in, such cases. Generally it is the chronic fibroid form confined to the apices, and may not be of great clinical significance, especially when tubercle bacilli are absent from the sputum. This is particularly true in older people in which this condition is most common. On the other hand, some forms of chronic tuberculosis slowly develop an associated emphysema which may be accompanied by bronchitis and asthma. When seen, the underlying tuberculosis may be masked by the other conditions and overlooked. Although presenting few if any symptoms of active tuberculosis, such cases frequently have large numbers of tubercle bacilli in the sputum and, unrecognized, form a class more dangerous to their associates than serious in themselves. A large portion of the so called tuberculosis carriers belong in this group and in many cases of active tuberculosis the source of their infection may be traced to them. Only systematic, thorough examination of all such patients, with tuberculosis in mind as a possibility, will eliminate this source of error and of these cases of new disease. Careful sputum and X-ray examination are the most important aids in their diagnosis.

b. Subacute or chronic bronchopneumonia or peribronchitis. This is an interesting group, very common, especially since the increased prevalence of influenza, and is often mistaken for tuberculosis. The infecting microörganism may be the pneumococcus, influenza bacillus or streptococcus.

The constitutional symptoms are mild and the fever of only a few days' duration. Cough and expectoration are marked and there may be an haemoptysis.

When the infection is due to influenza, catarrhal symptoms of the upper air passages are usually present and the accessory nasal sinuses are frequently involved.

The physical signs are the same as those of tuberculous infiltration, but are almost always in the lower lobes and are extensive, often involv-

ing an entire lobe. The sputum examinations fail to reveal tubercle bacilli, but one or more of the three above mentioned microörganisms are found in large numbers and often in pure culture.

The X-ray shows either nothing abnormal or simply an intensification of the normal bronchial shadows, linearly distributed, and never the fluffy irregular distribution of parenchymal tuberculous disease.

The condition may entirely clear up in a few weeks or it may only partially do so, to be followed by recrudescence in the following weeks or months. Or it may persist and develop into a chronic condition with fibrosis, occasionally resulting in bronchiectasis.

The persistence of the cough and expectoration and the physical signs invite the erroneous diagnosis of tuberculosis. In the cases in which haemoptysis occurs, this mistake is almost invariably made.

The differential diagnosis from tuberculosis rests upon the localization of the lesions in the lower lobes, the absence of constitutional symptoms in the presence of extensive physical signs, the absence of tubercle bacilli in the sputum and the presence of the microörganisms of acute respiratory infection, the character of the X-ray picture and the disappearance of signs and symptoms in the majority of instances far more quickly than would be possible in tuberculous lesions of similar extent.

c. Bronchiectasis. The history of bronchiectasis is one of chronic cough, often paroxysmal in character, usually dating from an attack of pneumonia or so called grippe. This cough is punctuated by the periodic expectoration of large quantities of purulent and often foul sputum. Such gushes of expectoration are frequently precipitated by certain positions of the body, sudden exertion, laughing, eating, or are often without apparent cause, and render the patient a most unpleasant companion and disgusting even to himself. His general condition is poor, he loses weight, tires easily, is short of breath, he becomes cyanotic with clubbed fingers and before long is unable to work and, sensitively avoiding the society of others, he is altogether a very miserable object. Periodically, especially in winter, he is ill in bed with fever and aggravation of his other symptoms, and occasionally there is spitting of blood. This condition goes on for many years, is slowly but persistently progressive and finally the patient succumbs to inanition, pneumonia, large haemorrhage, or some associated complication.

The signs in the chest are variable and often very indefinite, depending largely upon the type of disease of which there are mainly three, namely, the infiltrative, the fusiform or cylindrical, and the sacculated bronchi-

ectases. The lesions may be single but are very frequently multiple and bilateral. They are almost always situated in the lower lobes, but may be found in the upper. In this situation they may be associated with or dependent upon a tuberculous lesion. If the bronchiectasis is single, the localization of physical signs over the lower lobe behind, presenting evidence of pleuritic adhesions, consolidation, localized bronchial catarrh, or more rarely a definite cavity, makes, with the history and the persistent absence of tubercle bacilli from the sputum, a fairly definite clinical picture which is usually satisfactorily completed by the X-ray.

With multiple and bilateral lesions, especially in the earlier stages, represented by the infiltrative type, the difficulties are much greater and the physical signs are usually those of a chronic bronchitis with or without pulmonary emphysema. During the exacerbations with fever, which are often really attacks of bronchopneumonia, there may be a polymorphonuclear leucocytosis. Again, in these types, the history, the negative sputum and the X-ray must determine the diagnosis.

CONCLUSION

In conclusion may I emphasize the fact that methods of more or less scientific precision, such as tuberculin tests, sputum examinations, the X-ray and complement fixation reactions, indispensable as they are, frequently fail or even confuse the diagnostician, and that in the last analysis the diagnosis of pulmonary tuberculosis, as indeed most other internal diseases, depends mainly upon the development of that clinical sense on the part of the physician, the pursuit of which constitutes much of the fascination of the practice of medicine; and further, that justice to patients and the profession alike demands that those who see a good deal of pulmonary disease should constantly keep in mind the not unlikely possibility that a thorough general examination may explain quite otherwise the suspicious symptoms which are apt to be ascribed solely to the lungs; and that certain definite physical signs in the chest may be susceptible of quite other interpretation than the temptingly obvious one of tuberculosis.

He who learns this lesson well, will, I believe, recognize tuberculosis when he encounters it even better than before.

POINTS IN THE DIAGNOSIS OF PULMONARY TUBERCULOSIS

A SYNOPSIS

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The following assertions, under the various captions, are not to be taken as all-inclusive. Exceptions undoubtedly occur. An attempt is made to give merely those facts which exist in more than one half of all cases of pulmonary tuberculosis.

To diagnose pulmonary tuberculosis, we must include a diagnosis of:

A. Tuberculous infection.

B. Tuberculosis (clinical disease).

C. Pulmonary tuberculosis (a focus in the lungs).

D. Activity of the pulmonary focus.

An attempt is also made to state the more common conditions which may simulate pulmonary tuberculosis and a few points which may be of value in differential diagnosis. The latter are not to be considered in an absolute sense, as here also exceptions undoubtedly do occur. Nor is the list of conditions, or the list of points in diagnosis, to be considered complete.

A. Tuberculous infection.

- I. Skin tests (intradermic test applied in decimally increasing strengths probably best).

  May not react:

  - a. Improperly applied (von Pirquet scarification incorrect, allowing insufficient time for proper absorption).
  - b. Too weak solution.
  - c. Acute infectious diseases.
  - d. No tuberculous infection.
- II. Subcutaneous tests.
- III. Tubercle bacilli.
- IV. Positive complement fixation.

B. Tuberculosis.

- I. Demonstration of tubercle bacilli.

II. Probably a positive complement fixation, present at least twice, two or more weeks apart.

C. Pulmonary tuberculosis.

I. Symptoms.

a. Hemoptysis of dram or more, especially if out of a clear sky and occurring in the absence of an acute epidemic of respiratory disease, is in about 90 per cent of cases due to pulmonary tuberculosis.

b. Pleurisy with effusion, or a substantiated dry pleurisy, not coming during an epidemic of acute respiratory disease, most likely (50 per cent to 75 per cent) due to pulmonary or pleural tuberculosis.

II. Physical signs.

a. Bronchovesicular breathing and increased vocal resonance at right apex insufficient, unless very well marked. May be caused by:

1. Anatomic variations.
2. Deviation of trachea due to enlarged thyroid.
3. Scoliosis with convexity to right in cervico-dorsal region.
4. Possibly muscular tenseness or improper nasal or oral breathing.

b. Cog-wheel breathing occurs so frequently in other conditions as not to be of great value.

c. Granular breathing is so often confused with scapular and other friction sounds as to be misleading.

d. Definitely distant breathing is very suggestive of pleurisy, pneumothorax or even infiltration.

e. Marked bronchovesicular or bronchial breathing, with marked increase of vocal resonance, bronchophony or pectoriloquy, denotes existing changes due to pathological conditions, namely, infiltration, consolidation, cavitation, retraction or fibrosis.

f. Râles. When persistent and fixed for a week or more, they are almost pathognomonic of tuberculosis, if located in upper half of chest only. May be unilateral, in which case the evidence is stronger, or bilateral. Râles extending continuously, or even brokenly, from the apex downward, are very significant of tuberculosis.

g. Râles may be present without changes in dulness or breath sounds.

h. Dulness, sometimes hyperresonance, may be present without marked changes in breath sounds.

III. X-ray.

a. Peribronchial beading and accentuation may be present when tuberculosis cannot be proved.

b. Definite parenchymatous infiltration (mottling) is very significant of tuberculosis when localized above the third rib or when unilaterally scattered through the lung. Always look for evidence of tuberculization. Consolidation, cavitation, fibrotic changes, interlobar conditions and localized homogeneous lessened transmissions of ray occur frequently in tuberculosis.

IV. Laboratory.

a. Sputum. Bacilli demonstrated, especially more than once, the nearest positive proof of pulmonary tuberculosis available.

b. Complement fixation test is positive in positive sputum cases most often. (Complement fixation test may be positive when tuberculosis exists elsewhere than in the lungs.)

D. Activity.

I. Symptoms.

a. Positive:

1. Elevation of temperature (toxicity).
2. Increased rapidity of pulse (toxicity).
3. Pleurisy, dry or wet (at least temporary activity of pleural focus, and probably intrapulmonary focus).

b. Suggestive:

1. Hemoptysis. (Quite a few occur as accidents in the course of the disease. Activity may be the cause, or activity may or may not follow upon hemoptysis.)
2. Streaked sputum.
3. Languor.
4. Dyspnoea. (When sudden and marked, look out for pneumothorax, also for miliary tuberculosis.)
5. Nightsweats.

6. Progressive loss of weight.
7. Anorexia.

II. Physical signs.

a. Recent pleurisy.
b. Crepitant râles.
c. Presence or absence of the ordinary râles does not mean anything as regards activity.
d. Recent bronchopneumonia or consolidation.

E. Differential diagnosis. Most difficult when minimum or extensive physical signs are present, or when minimum X-ray evidence is present.

I. Minimum physical signs or no physical signs; minimum X-ray or negative X-ray findings:

a. Hyperthyroidism.
b. Neurasthenia, psychasthenia.
c. Focal infections:
   1. Teeth.
   2. Sinuses.
   3. Bowels.
d. Cardiac conditions.
e. Renal conditions.
f. Gall bladder disease (stones).
g. Diabetes.
h. Syphilis.
i. Typhoid fever.
j. Secondary anemias.
k. Leukemias.
l. Hodgkin's disease.

II. Extensive physical signs:

a. Bronchitis.
b. Pneumonias.
c. Bronchopneumonias.
d. Abscesses.
e. Malignancy.
f. Streptothrix.
g. Actinomycosis.
h. Fungous infections.

(However, any of the above may be present with only moderate extent of physical signs or moderate X-ray findings, and, with

the exception of lobar pneumococcus pneumonias, may be present in the same individual.)

F. Points in differential diagnosis.

I. Râles above third rib, when persistent and fixed, are apt to be due to tuberculosis.

II. Râles, below the third rib only, are probably nontuberculous.

III. Physical signs absent above the second rib, condition probably nontuberculous.

IV. X-ray lesion only peribronchial may or may not be tuberculous.

V. For tuberculosis (X-ray) look for tuberculization. Remember anthracosis, etc., post-influenzal or post-measles bronchopneumonias.

VI. When tuberculization not definite, look out for bronchopneumonias, pneumonias, abscess, bronchiectasis, malignancy, etc.

VII. Sharply demarcated lesions with no evidence of disease surrounding the demarcated area, when involving less than a lobe (more than one may be involved), are probably not tuberculous.

VIII. Always be on the lookout for malignant growths of the mediastinum and pleura and along the bronchi, and extending from the root.

IX. Tuberculosis of the lungs may exist with no demonstrable X-ray lesion at the time.

X. Ascertain the amount, character and time at which most sputum is raised.

XI. Be sure to examine the sputum frequently and to use the concentration methods. Employ guinea pig inoculation or test-tube implantation upon Petroff's medium.

XII. The complement fixation test for tuberculosis and for syphilis will often prove of great worth. Syphilis should always be excluded when in doubt.

G. Finally, before making a diagnosis of pulmonary tuberculosis, have one or more of the following positive findings:

I. Hemoptysis, as described under diagnosis.

II. History of pleurisy with effusion, or a substantiated dry pleurisy, as described under diagnosis.

III. Râles, persistent and fixed, in the upper half of the chest.

IV. A definite parenchymatous X-ray picture, showing tuberculization or mottling.

V. A positive complement fixation for tuberculosis.

VI. Tubercle bacilli in the sputum.

Some of the above may be present when pulmonary tuberculosis does not exist, but the majority of cases of pulmonary tuberculosis have two or more of these present. Be sure to have at least one.

THE IMPORTANCE OF PHYSICAL SIGNS IN THE PROGNOSIS OF PULMONARY TUBERCULOSIS

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In many cases of pulmonary tuberculosis we find that during the course of treatment the patient loses his cough; his fever drops and remains normal; he gains weight, and often reports that "he never felt better in his life;" and yet the physical signs have remained stationary or have even advanced slightly. When we are confronted by such a patient what should be our advice to him regarding his further treatment and prognosis? In other words, which should carry the more weight in our mind, the decreased symptoms or the stationary or increased signs? In order to try to shed a little light on this question, the following work was undertaken.

The physical signs on admission were compared with those on discharge in 1000 consecutive cases admitted to the Trudeau Sanatorium, starting with those patients admitted during 1907 and working through to the admissions of 1913. The condition of these 1000 cases in 1918, or from five to eleven years after discharge, was then looked up and the results analyzed, three points in particular being studied:

First, during their stay at the institution, with an average residence of five and one-half months, do the physical signs of most of the patients show an increase, a decrease or do they remain stationary?

Second, do the patients who leave the institution with decreased signs show a lower mortality or remain well longer than their less fortunate companions whose physical signs refuse to clear up, or even slightly advance?

Third, is it possible in any way to compare symptoms with physical signs as regards the prognosis of our patients?

As a possible solution to these questions the following tables have been worked out. Before taking up a detailed study of them, a few preliminary explanations may be needed.

In the first place, 21 of our 1000 cases were not used for the reason that, for one cause or another, these patients did not have an admission

or discharge examination, or they died while in the sanatorium or diagnosis on the discharge record was marked "doubtful." This leaves us a total of 979 cases for study.

By the terms "Increased," "Decreased" or "Stationary" signs we have reference only to râles, as they seem by physical examination the most diagnostic sign of tuberculosis, beside which the personal opinion of the examiner as to their presence or absence plays a less important rôle than in the case of dulness or changes in breath sounds.

The terms used under "Condition on Admission," that is, "Incipient," "Moderately Advanced," and "Far Advanced;" and those adopted under "Condition on Discharge," that is, "Apparently Arrested" (formerly "Apparently Cured"), "Quiescent" (formerly "Arrested") and "Active" ("Improved, Unimproved or Failed") are those adopted by this Association, and need not be gone into here.

The present condition of these patients is taken from the reports of 1918, for at the time this paper was started all the 1919 reports had not yet come in. The classification of "Well," "Living," "Dead" and "Unknown," is also one adopted by the National Tuberculosis Association, "Well" referring to those patients who have been working for the past two years, while the "Living" group is largely made up of the less fortunate who have either relapsed or become chronic. This group also contains patients whom we know are alive but about whom we are unable to get any further information. Under the heading of "Well" we have also noted the number and percentage of relapses, while under the heading of "Dead" the number and percentage of these deaths caused by tuberculosis have been reported.

We may turn first to table 1 and seek there, if possible, the answer to the first of our questions, namely, do the physical signs in the majority of our patients increase, decrease or remain stationary during their treatment. In view of the fact that 675, or 69 per cent of all our 979 cases were discharged as either "Apparently Arrested" or "Quiescent," we would naturally suppose that in the great majority of these the signs would clear up slightly at least, in order to have so large a percentage discharged in such good condition. We find, however, the reverse, that is, 43.1 per cent show an increase in their râles, while only 40.6 per cent decrease, and 16.2 per cent remain stationary. This to me is a difficult point to explain.

The next question to be taken up is how much of an advantage it is to have a patient's signs improve before he leaves the institution.

TABLE 1A

Signs increased; 422 cases or 43.1 per cent of total 979 cases

CONDITION ON ADMISSION	CONDITION ON DISCHARGE	PRESENT (1918) CONDITION	NUMBER OF CASES	PER CENT	
Incipient 127 or 30.1 per cent	Apparently arrested 20 (15.7 per cent)	Well	14	70.0	3 relapsed
		Living	3	15.0	21.4 per cent
		Dead	2	10.0	
		Unknown	1	5.0	
	Quiescent 71 (55.9 per cent)	Well	51	71.8	14 relapsed
		Living	8	11.3	27.5 per cent
		Dead	11	15.5	9 tuberculous
		Unknown	1	1.3	81.8 per cent
	Active 36 (28.3 per cent)	Well	18	50.0	11 relapsed
		Living	9	25.0	61.1 per cent
		Dead	8	22.0	6 tuberculous
		Unknown	1	3.0	75 per cent
Moderately advanced 285 or 67.5 per cent	Apparently arrested 2 (0.7 per cent)	Well	1	50.0	1 relapsed
		Living			100 per cent
		Dead			
		Unknown	1	50.0	
	Quiescent 169 (59.3 per cent)	Well	103	60.9	26 relapsed
		Living	23	13.6	25.2 per cent
		Dead	42	24.9	36 tuberculous
		Unknown	1	0.6	85.7 per cent
	Active 114 (40 per cent)	Well	34	29.8	21 relapsed
		Living	19	16.6	61.7 per cent
		Dead	60	52.6	55 tuberculous
		Unknown	1	0.9	91.7 per cent
Far advanced 10 or 2.4 per cent	Quiescent 2 (20 per cent)	Well			
		Living			
		Dead	2	100.0	2 tuberculous
		Unknown			100 per cent
	Active 8 (80 per cent)	Well	2	25.0	1 relapsed
		Living			50 per cent
		Dead	6	75.0	6 tuberculous
		Unknown			100 per cent
Summary		Well	223	52.9	77 relapsed
		Living	62	14.7	34.5 per cent
		Dead	131	31.0	114 tuberculous
		Unknown	6	1.4	87.7 per cent

TABLE 1B

Signs decreased; 398 cases or 40.6 per cent of total 979 cases

CONDITION ON ADMISSION	CONDITION ON DISCHARGE	PRESENT (1918) CONDITION	NUMBER OF CASES	PER CENT	
Incipient 127 or 31.9	Apparently arrested 60 (47.3 per cent)	Well	53	88.3	8 relapsed
		Living	5	8.3	15 per cent
		Dead	1	1.7	
		Unknown	1	1.7	
	Quiescent 38 (29.9 per cent)	Well	31	81.6	8 relapsed
		Living	4	10.5	25.8 per cent
		Dead	2	5.3	
		Unknown	1	2.6	
	Active 29 (22.8 per cent)	Well	20	69.0	11 relapsed
		Living	7	24.1	55 per cent
		Dead			
		Unknown	2	6.9	
Moderately advanced 266 or 66.8 per cent	Apparently arrested 34 (2.7 per cent)	Well	28	82.3	5 relapsed
		Living	5	14.7	17.9 per cent
		Dead	1	3.0	
		Unknown			
	Quiescent 165 (62.03 per cent)	Well	113	68.5	27 relapsed
		Living	14	8.5	23.9 per cent
		Dead	36	21.8	28 tuberculous
		Unknown	2	12.2	77.7 per cent
	Active 67 (25.1 per cent)	Well	32	47.7	10 relapsed
		Living	13	19.4	31.2 per cent
		Dead	22	32.9	19 tuberculous
		Unknown			86.4 per cent
Far advanced 5 or 1.2 per cent	Quiescent 1 (20 per cent)	Well	1	100.0	1 relapsed
		Living			100 per cent
		Dead			
		Unknown			
	Active 4 (80 per cent)	Well			
		Living	3	75.0	
		Dead	1	25.0	1 tuberculous
		Unknown			100 per cent
Summary		Well	278	69.8	70 relapsed
		Living	51	12.8	25.1 per cent
		Dead	63	15.8	49 tuberculous
		Unknown	6	1.5	77.7 per cent

TABLE 1c

Signs stationary; 159 cases or 16.3 per cent of total 979 cases

Condition on admission	Condition on discharge	Present (1918) condition	Number of cases	Per cent	
Incipient 97 or 61.1 per cent	Apparently arrested 42 (43.3 per cent)	Well	39	92.8	5 relapsed
		Living	1	2.3	12.8 per cent
		Dead	2	4.7	1 tuberculous
		Unknown			50 per cent
	Quiescent 26 (26.8 per cent)	Well	22	84.6	6 relapsed
		Living	2	7.7	27.2 per cent
		Dead	2	7.7	2 tuberculous
		Unknown			100 per cent
	Active 29 (29.9 per cent)	Well	25	86.2	10 relapsed
		Living	4	13.8	40 per cent
		Dead			
		Unknown			
Moderately advanced 61 or 38.3 per cent	Apparently arrested 6 (9.8 per cent)	Well	5	83.3	
		Living			
		Dead	1	16.7	
		Unknown			
	Quiescent 38 (62 per cent)	Well	27	71.1	8 relapsed
		Living	8	21.1	28.2 per cent
		Dead	2	5.2	2 tuberculous
		Unknown	1	2.6	100 per cent
	Active 17 (27.8 per cent)	Well	5	29.4	1 relapsed
		Living	2	11.8	20 per cent
		Dead	9	52.9	8 tuberculous
		Unknown	1	5.9	88.9 per cent
Far advanced 1 or 0.6 per cent	Quiescent 1 (100 per cent)	Well	1	100.0	
		Living			
		Dead			
		Unknown			
	Active 0	Well			
		Living			
		Dead			
		Unknown			
Summary		Well	124	78.0	30 relapsed
		Living	17	10.7	25.8 per cent
		Dead	16	10.1	13 tuberculous
		Unknown	2	1.2	81.3 per cent

By reference to the table we see that for each group "Incipient," "Moderately Advanced" and "Far Advanced," the percentage of "Well" is higher and the percentage of "Dead" is lower for those patients whose physical signs have diminished; or, by looking at the summary at the bottom of the table, we note that of all patients showing a clearing up of their signs 69.8 per cent are well, while only 15.8 per cent have died as compared with 52.9 per cent of "Well" and 31 per cent of "Dead" among those whose signs have increased. It will thus be seen that a patient in whom the physical signs improve has proportionately a seven to five better chance of remaining well and double the chance of not dying within five to eleven years after discharge, when compared with a patient in whom the signs increased.

It will also be noted that among the former patients the chances of having a relapse or of having tuberculosis as the ultimate cause of death after leaving the sanatorium are respectively 25.1 per cent and 77.7 per cent as compared with 34.5 per cent and 87.7 per cent in the case of those with an increase of signs.

TABLE 2

Summary of present condition (1918) of 511 arrested cases

	NUMBER OF CASES				PER CENT			
	Increase	Decrease	Stationary	Total	Increase	Decrease	Stationary	Total
Well	154	145	50	349	63.6	71.1	76.9	68.3
Living	31	18	10	59	12.8	8.8	15.4	11.5
Dead	55	38	4	97	22.7	18.6	6.2	19.0
Unknown	2	3	1	6	0.8	1.5	1.5	1.2
Total	242	204	65	511	100.0	100.0	100.0	100.0

Our third and last point to be considered is whether there is any way of comparing the value of symptoms with physical signs as regards prognosis. In order, therefore, to get some idea of the rôle played by a change in physical signs would it not be fair to take our cases which were discharged as "Quiescent" or "Arrested," divide them into three groups, depending on whether their signs have progressed, retrogressed or remained unchanged, and then compare the present condition of each one of these groups? This will be seen in table 2. Of our total of 979 cases, 511 were discharged as "Arrested." Of these arrested cases, 68.3 per cent were well in 1918, while 19 per cent had died and 11.5 per cent were living. Of those with increased signs 63.6 per cent

are well, 22.7 per cent are dead and 12.8 per cent are living. Of those with decreased signs, the figures are 71.1 per cent, 18.6 per cent, and 8.8 per cent, while for the stationary cases we get 76.9 per cent, 6.2 per cent, and 15.4 per cent. It will be noted that the highest percentage of "Well" and the lowest death rates are in the stationary group. This undoubtedly is explained by the fact that 49 per cent of patients in this group were without râles, and hence, as is to be expected, did very well.

Table 3 is presented in order to show how a progression or a diminution of physical signs compares with the grand total of all our cases regardless of their condition on admission or discharge. The same general trend

TABLE 3

Summary of present condition (1918) of total 979 consecutive cases; discharged from Trudeau Sanatorium from 1907 to 1913

	NUMBER OF CASES				PER CENT			
	Increase	Decrease	Stationary	Total	Increase	Decrease	Stationary	Total
Well	223	278	124	625	52.8	69.9	77.9	63.8
Living	62	51	17	130	14.7	12.8	10.7	13.3
Dead	131	63	16	210	31.1	15.8	10.1	21.5
Unknown	6	6	2	14	1.4	1.5	1.3	1.4
Total	422	398	159	979	100.0	100.0	100.0	100.0

will be noted as in table 2, which we have just been considering, that is, of those with increased signs 52.8 per cent are well, 31.1 per cent are dead and 14.7 per cent are living. Of those with decreased signs the figures are 69.9 per cent, 15.8 per cent and 12.8 per cent, while for the stationary cases we get 77.9 per cent, 10.1 per cent, and 10.7 per cent.

Before closing I wish to express my appreciation to Dr. Brown for instituting a system of records with a follow-up system which has worked so satisfactorily that only 14 or 1.4 per cent of the 979 cases treated in this paper are untraced.

I also wish to express my thanks to Mr. George Milan, our statistician, for his many helpful suggestions.

CONCLUSIONS

1. In spite of the fact that practically 70 per cent of the patients in our series were discharged as "Apparently Arrested" or "Quiescent," 44 per cent showed an increase in their physical signs during their stay in the institution, 41 per cent showed a decrease, while 16 per cent remained stationary.

2. Among the patients in our series in whom the physical signs diminished one-third more were well, one-half less were dead, one-ninth less of the deaths in which the causes were known were caused by tuberculosis, and there were about one-fourth fewer relapses at the end of from five to eleven years than in the cases of those patients in whom signs increased.

3. In regard to the arrested cases 68.3 per cent are well, 19 per cent are dead and 11.5 per cent are living after a period of from five to eleven years after discharge, regardless of the change of physical signs. Of those with increased physical signs 63.6 per cent are well, 22.7 per cent are dead and 12.8 per cent are living. Of those with decreased physical signs 71.1 per cent are well, 18.6 per cent are dead and 8.8 per cent are living, while those with stationary physical signs show 76.9 per cent well, 6.2 per cent dead and 15.4 per cent living.

In dealing with all cases in our series, regardless of admission or discharge condition, and also of physical signs, 63.8 per cent are well, 21.5 per cent are dead and 13.3 per cent are living after a period of from five to eleven years after discharge. In all our cases, however, showing increased signs, 52.8 per cent are well, 31.1 per cent are dead, and 14.7 per cent are living. Of those with decreased signs, 69.9 per cent are well, 15.8 per cent are dead, and 12.8 per cent are living, while, for the stationary cases, 77.9 per cent are well, 10.1 per cent are dead and 10.7 per cent are living.

4. Whether for arrested or for all cases, patients with stationary physical signs (absence of, or no change in, râles) do best, while those with decrease of râles do better than those with an increase.

5. Physical signs and the symptoms cannot be compared separately but should be considered together in making a prognosis.

AN INVESTIGATION OF THE ACID FASTNESS OF TUBERCLE BACILLI II

B. SUYENAGA

From the Otho S. A. Sprague Memorial Institute and Pathological Laboratory of the University of Chicago

In a previous report on this subject, I showed that rapid transfer of the border or younger portion of colonies of K1, a saprophytic nonvirulent strain of tubercle bacilli, did not materially affect its acid fastness. In other words, I was unable to prove by this method that younger cultures are much less acid proof than older ones. I also changed the metabolic conditions of the culture by using different reactions, which had no marked effect on the acid fastness, and by non-nutrient media and the amoeba media used by Wherry, both of which greatly reduced the acid fastness without absolutely destroying it. The question that especially needs answer is whether, in any such culture as K1, in which we find many acid-fast, but also many non-acid-fast bacilli, we have a culture consisting of two distinctly different strains or whether the bacilli merely differ from each other as a result of age, metabolic conditions or degenerative changes. If we have two distinct strains, one may be a mutation strain or the two may be foreign to each other and live together symbiotically.

Two possible methods suggested themselves which might separate the non-acid-fast from the acid-fast strain, if the two existed as separate and distinct strains in the saprophytic culture used by me. Churchman had suggested that gentian violet and methylene blue, though in different degrees, might separate from each other Gram-positive and Gram-negative strains which were growing together. He showed that the Gram-positive strains were completely inhibited by the dyes. It was my hope that the same dyes might separate the acid-fast from the non-acid-fast strain by inhibiting or killing one of them. The bactericidal power of these dyes was tested on K1 and other acid-fast or partly acid-fast organisms, such as avian and frog tubercle bacilli and leprosy bacillus and on a number of non-acid-fast rapidly growing organisms (B. prodigiosus, B. subtilis, B. coli and Staphylococcus aureus). The

amount of the dye necessary to make the desired dilution was added to a broth culture which was then incubated for two hours and kept at room temperature from three to four hours. A definite amount was then transferred to plain agar slants. Neither gentian violet nor methylene blue had any bactericidal action except on Staphylococcus aureus. This was killed by 1 to 10,000 gentian violet and mostly by 1 to 5000 of methylene blue. In another experiment, B. subtilis was killed by gentian violet in a dilution of 1 to 1000, and B. coli and B. prodigiosus by a dilution of 1 to 200. In the case of the acid-fast organisms, which after exposure to the dyes were inoculated on glycerol agar, K1 seemed not to be killed by any dilution used, but the avian and frog tubercle bacilli were killed by all dilutions used of both dyes, the highest being 1 to 1000, while the leprosy bacillus was killed by 1 to 500 and much delayed in its growth by 1 to 1000. A concentration of 1 to 100,000 of either gentian violet or methylene blue, using the Churchman divided plate method, seemed to have no inhibitory effect on the growth of any of the organisms on plain agar except B. subtilis and Staphylococcus aureus, while 1 to 1000 gentian violet completely inhibited the growth of K1, timothy bacillus, grass bacillus, mist bacillus, smegma bacillus and Bacillus subtilis and Staphylococcus aureus. Methylene blue, 1 to 1000, completely inhibited the growth of timothy bacillus and Bacillus subtilis and delayed the growth of K1. On glycerol agar, the results are somewhat different. K1 shows no inhibition even at 1 to 1000 of either dye, while avian and frog bacilli are inhibited completely by 1 to 100,000 of gentian violet and by 1 to 1000 methylene blue. Leprosy bacillus is completely inhibited by 1 to 10,000 gentian violet and by 1 to 1000 methylene blue.

It was found on the divided plates that frog bacilli and avian bacilli, which are least acid-fast, were most susceptible to the action of the dyes, that they grew only on the undyed portion and that their growth never extended near the line separating the dyed and the undyed portions, while K1, leprosy and smegma bacilli grew entirely across the plate, if the concentration of the dye did not exceed 1 to 100,000. In order to determine whether the bactericidal and inhibitory action of these dyes would prove a feasible method for separating acid-fast from non-acid-fast organisms, cultures of K1 after exposure to gentian violet and methylene blue were stained by the Ziehl-Nielsen method and it was found that acid-fast and non-acid-fast organisms were still mixed.

The second method which suggested itself for separating these two types of bacteria, which should succeed if they represent two separate and distinct strains, is the method used by Petroff for isolating tubercle bacilli from other organisms which may occur in the sputum. K1 culture was exposed for from ten minutes to five hours to sodium hydroxide, then neutralized and inoculated on Petroff's egg media and on glycerol agar. Sodium hydroxide, 1.5 per cent, killed all organisms even in ten minutes, so that no growth occurred. Sodium hydroxide, 0.5 per cent, did not kill all in one hour but did in two hours. A virulent culture was also exposed to 0.5 per cent sodium hydroxide. No growth occurred on the glycerol agar slants even after ten minutes' exposure, but there was growth on all the Petroff media containing 1 to 10,000 gentian violet, even after five hours. The mixture of acid-fast and non-acid-fast bacilli in the tubes, in which growth occurred after the exposure to sodium hydroxide, shows that these two types of bacilli could not be separated by this method and suggests therefore that they are not distinct strains.

If this is true, they must probably be phases in the growth of the tubercle bacillus. Ehrlich, Marmorek, Klein and others regarded the non-acid forms as merely the youngest phase in the development of the tubercle bacillus. Many have thought that the fatty sheath, which is supposed to contribute to the acid fastness of the bacillus, develops later. By increasing the rapidity of the growth and thus developing a strain which should consist only of young bacilli I endeavored without success in my earlier work to show that the age of the culture had much to do with its staining qualities. Metabolic conditions seem, from my former report, to affect markedly the acid fastness of these organisms, since media of low nutritive value greatly diminished their acid fastness. Degenerative conditions due to the age of the culture and the consequently lowered nutritive value of the media may be a possible factor in increasing the number of non-acid fast bacilli. But that question has not as yet been investigated.

CONCLUSIONS

1. Since it has not proved possible, by the methods used, to separate an acid-fast strain from a non-acid-fast, it is probable that we have here no distinct strains, either mutation or symbiotic.

2. Since the marginal growth of K1 seems to contain more non-acid-fast organisms than the central portion and since some non-acid-fast organisms occur even in virulent cultures, it seems probable that the younger bacilli may for a short time be non-acid-fast. The question whether the non-acid-fast forms may be degeneration forms has not been investigated.

3. Gentian violet has a stronger bactericidal and inhibitory power than methylene blue over saprophytic acid-fast and some Gram-positive and Gram-negative organisms.

4. There is considerable difference between the bactericidal and the inhibitory power of these antiseptic dyes.

5. Of the acid-fast bacilli, the less acid-fast seem more susceptible to the action of gentian violet and methylene blue.

ARTIFICIAL HELIOTHERAPY IN PULMONARY TUBERCULOSIS

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In the winter of 1917 we began the use of artificial heliotherapy on every patient in the tuberculosis pavilion of the Jewish Home for Chronic Invalids irrespective of the condition in the lungs.

Since many of our patients were bedridden and we had only one lamp we were compelled to use a technique where we could expose a maximum number of patients in a given period. In all we have rayed some fifty or more patients and a résumé of our findings is the subject of this report.

At first we gave each patient preliminary preparation consisting of exposure of the feet for five minutes, followed forty-eight hours later by a ten minute exposure of the feet and one of five minutes of the legs and continuing upward until reaching the chest, each new segment receiving five minute exposures while those below received ten, fifteen, twenty, twenty-five and thirty minute exposures, respectively, depending on their distance from the segment last rayed.

Later we discontinued this preliminary preparation and began at once with a five minute exposure of the front of the chest, repeating this every Tuesday, Thursday and Saturday until twelve five minute exposures had been given, after which we exposed the back of the chest in the same way and for the same length of time, at the same time increasing the anterior exposures to ten minutes. This five minute increase after 12 exposures was continued until fifteen minutes was reached and twelve exposures given for that length of time. This constituted a course of treatment, of 36 rayings each to the front and back of the chest, 12 of each for five, ten, and fifteen minute periods.

A goodly number of the bedridden patients refused to complete the course, largely on account of the effort and strain of being lifted from bed to recliner and from recliner to bed and the discomfort of dressing and undressing. Several showed blood streaked sputum or small quantities of free blood which might well have been due to the physical exertion and not to the rays themselves. One patient who showed good tanning

suddenly developed several large blebs and later pulmonary hemorrhages, which was the first blood-spitting she had ever had.

Skin reactions. The first sign of the ray, occurring within twenty-four to forty-eight hours, is an erythema which usually causes no discomfort but in certain patients manifests itself as a mild irritation of an itching, burning character, which gradually disappears and in most cases causes no further complaint. As the raying continues, the intensity of the reddening increases and the latter takes on a deeper hue. This is especially frequent in individuals with light complexion and remains unaltered throughout and long after a full course of treatment, while in the majority of the brunette type of patients the red gives way to a light tan. Except in a few blondes where localized patches (freckles) of tanning occurred, changes in the color of the skin were uniform over the whole surface treated. The eyes were protected by means of blue-colored goggles and we soon were compelled to cover the head to avoid the peculiar dry feeling of the head and hair so frequently complained of. It may be interesting to state that the unprotected eyes soon (within a few hours) show conjunctival reddening, that photophobia becomes marked, and that any attempt at closing the lids gives rise to a peculiar sensation as though someone were rubbing the eye ball with fine sandpaper, and sleeping is impossible. This annoying condition soon subsides and after forty-eight hours no trace of its presence remains. The forehead after numerous exposures changes from red to tan and flaky exfoliation is constant. Flaking of the superficial skin of the chest occurred frequently in our series without, however, any definite regularity either as to number of treatments or complexion, yet more frequently in the blonde type. The only serious skin condition we met with was the case of the patient above referred to, who developed several large blebs over the front of the chest, on account of which we had to discontinue the treatment.

Temperature reactions. We do not feel warranted in expressing any definite opinion except to state that the rays of themselves cause little if any temperature changes.

Pulse reaction. We also were unable to find any changes in the pulse rate as being directly caused by the light.

Sputum and cough. Except in rare instances these showed no variation from what we considered usual for the particular patient before beginning treatment.

General reaction. Aside from the benefit accruing from the thought that a new treatment was being used we could see no changes in the constitutional reaction of the patients.

Reaction in the lungs. We feel that the degree of activity is the only logical method whereby we can determine the immediate effect of light treatment so that if, as a result of a course of rayings, a patient whose process was active but stationary before treatment, showed spreading activity, that process was probably aggravated by such treatment. On the other hand a patient whose process showed progressive activity, which improved after treatment, was very likely benefited by the rays. If a process showed no changes subsequent to treatment the focus was unaffected by the rays.

Now many strange happenings occur with light. For example, a patient who had resided in the sanatorium for six months and showed a widespread process over both lungs, fibrotic in tendency but inactive, was given one five minute exposure early in March of this year and forty-eight hours later for the first time since admission showed blood-streaked sputum. Again, a boy sixteen years old with an active focus in the left upper lobe but with negative sputum, was given treatment which totaled thirty-six hours; and physical examination, the screen and X-ray plate, as well as constitutional signs, failed to show the slightest changes either in the patient or his lung process. Assuming that the blood-streaked sputum in the first case was not coincidental but was indeed due to the treatment, we find it difficult to understand how, according to the theory of Petersen, a change in the ferment-antiferment balance could bring about so violent a reaction while in the second case no reaction took place. It may of course be presumed that in the first case the tuberculous foci were numerous and but weakly invested and only a minimum of change in the ferment-antiferment balance was needed to bring about a definite though undiscovered change in the lungs, while in the second case the focus was so well invested that no amount of rays was sufficient to upset this balance. And if we subscribe to Petersen's conception, then light like tuberculin, or iodides, brings about the same changes in the tuberculous focus; and from it we postulate that destructive and degenerative, not constructive and reparative processes, ensue, since we have never seen active tuberculosis of the lungs improve either under tuberculin, iodine or iodide therapy. But while light rays, physical in their nature, may bring about changes in the body through a mechanism similar to that of drugs or bacterial products, certain phenomena peculiar

to themselves differentiate the effect of such rays and place this form of therapy in a class by itself. It is to this particular phase of the subject that attention should be directed. Artificial heliotherapy in lung tuberculosis is not curative nor can one say it is reparative; but we believe it does that which nothing heretofore has done so well, namely, it convinces us that patients whom we have been led to believe have reached a stage of quiescence are safe for return home and for work; for we have yet to have a patient discharged as recovered. who has been subjected to the lamp treatment, return to us, and as far as we know to any other institution.

Another distinct value of the lamp is its aid in proving the absence of "suspected tuberculosis," of "doubtful tuberculosis," of "incipient tuberculosis" that does not exist. On the other hand our experience forces us to believe that in definitely proved tuberculosis, activity is in many cases aggravated and inactive lesions reactivated.

We do not wish to be understood as condemning the treatment since our experience with it is comparatively small and our knowledge of its action immature; but our observations from a purely clinical standpoint on some 50 to 60 patients lead us to believe that it holds out little hope as a curative agent in lung tuberculosis.

INFLUENZA AS A FACTOR IN THE ACTIVATION OF LATENT TUBERCULOSIS[1]

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During the pandemic of 1889 and 1890 the late Dr. William C. Glasgow (1), of St. Louis, with whom I was associated, called attention to the frequency with which active tuberculosis followed influenza, and concluded that lungs which did not clear up within eight or ten weeks after the attack of grippe were in many cases actively tuberculous. Influenced, therefore, by our experience in this former epidemic, we were desirous of observing whether the same phenomenon would recur, and, if so, to what extent in the more recent pandemics.

Early in December, 1918, while the disease was still raging in our city, we encountered active tuberculosis in a number of people, who had been seized with influenza only a few weeks previously, a large percentage of whom stoutly asserted that they had always maintained their usual standard of health up to the time of their grippal attack.

In this investigation of the subject, it is my intention to consider solely those phases of the influenzal infection and consequent tuberculous disease occurring among those who, previous to their influenzal attack, had never manifested any signs or symptoms of active tuberculosis, but, on the contrary, had always maintained, in so far as could be accurately ascertained, their normal standard of health and pulmonary integrity.

By latent tuberculosis, therefore, is meant that period of infection from the time of its implantation and circumscription to the time of the supervention of active tuberculous disease. Cases of known tuberculosis, that have been excited to renewed activity, or in whom the already existing activity has been aggravated, are not considered.

Is influenza a frequent and potent factor in the causation of active tuberculous disease in those previously free from it? As this is primarily a question of fact, a few observations, statistics and opinions are

[1] Read before the Clinical Section of the Sixteenth Annual Meeting of the National Tuberculosis Association, Saint Louis, Missouri, April 23, 1920.

submitted with the hope of establishing the thesis and eliciting from others their experience in this regard.

Four hundred and nine cases of proved active tuberculosis in all stages were admitted to Mount St. Rose Sanatorium from January 1, 1919, to March 25, 1920, a period of fifteen months. Of this number 97 or 24 per cent gave a history of influenza during the pandemic of 1918 and 1919 or the epidemic of 1919 and 1920. Of these 97 who had had influenza, 62 or approximately 62 per cent gave a history of previous health prior to their influenzal attack, and attributed the tuberculosis thereto. Thus in 15 per cent of all cases admitted during that period active tuberculosis was the direct result of an influenzal attack.

In private and consulting work, 22 per cent of those giving a history of influenza were actively tuberculous. All doubtful cases are excluded; all had positive sputum in both series. In ten of the cases in private practice the pulmonary status was personally and accurately known and recorded by previous physical examinations as being free from pulmonary disease prior to their influenza. The apparent discrepancy in these statistics is readily accounted for by the fact that those, who are admitted to Mount St. Rose, are already advanced or at least frankly tuberculous, whereas many of those, seen in private work, exhibited simple post-grippal, nontuberculous symptoms. Of great and cogent value is the experience of Captain Robert S. Berghoff (2), who accurately knew the pulmonary conditions before and after the influenzal attack. "Of thirteen cases of healed and quiescent tuberculosis, presenting at no time evidence of moisture or positive sputum, six cases or approximately 50 per cent showed a reactivation and positive sputum after an attack of influenza."

W. D. Tewksbury (3) states that in four months, from December, 1918, to March, 1919, 104 patients were admitted to the tuberculosis hospital at Washington. In 27 there was a history of apparent health previous to the influenza. Therefore over 25 per cent of the cases admitted were the direct sequelae of influenza. In the Health Department Clinic and in private practice 102 were examined, of whom 37 were tuberculous. "On account of the history of perfect health before the influenza, the conclusion is irresistible that this entire series of 64 cases of pulmonary tuberculosis was due to a lighting up by the influenza of old healed tuberculous foci in the lung or hilum. . . . They were in perfect health when struck down by influenza."

In a personal communication, Dr. Edward R. Baldwin says, "Judging from my histories, however, there were in 200 cases from September 1, 1918, to January 1, 1920, 52 cases who attributed the beginning of their tuberculosis, or aggravation of it, to the influenza."

In a similar communication Dr. S. A. Newman, Medical Director of Missouri State Sanatorium, writes, "Without going fully into the records, I could state that 40 per cent of our applicants date their tuberculosis from an attack of influenza in 1918 or 1919. Many of them gave no history of tuberculosis prior to the influenzal attack, but in the history obtained some of them indicated that they had the disease in a quiescent or arrested condition, and that the disease was reactivated by an attack of influenza."

Doctor Martin F. Sloan, Medical Director, Eudowood Sanatorium, Towson, Maryland, in a personal letter, states, "Our census report from October 1, 1918, to August 30, 1919, shows that 151 patients were admitted; 44 or 20 per cent had had influenza; 7 of the 44 were known to have had tuberculosis prior to having had the influenza; 11 had had symptoms at one time or another, though no diagnosis had been made; 26 or 19 per cent had had no evidence whatever of clinical tuberculosis prior to the influenza. I have not analyzed our figures since then, but believe that they will parallel pretty closely the figures given. I am quite sure that the recent pandemic of influenza has had a decided influence on latent tuberculosis and, unfortunately, the gravity of the situation is not appreciated by the average physician."

Of course, a definite percentage of the cases of latent tuberculosis, activated by the recent epidemics of influenza, cannot be given with precision, simply because the incident is not as yet closed, as we are still encountering cases of active tuberculosis of indubitable influenzal origin, dating back to the pandemic of 1918, as well as to that of 1919–1920. Unfortunately many of these cases have suffered irreparable damage before the condition was recognized. Lulled into a feeling of false security, many of them have been considered as "the remains of influenza," "post-influenzal lungs," that would clear up in time, until the tuberculosis is so apparent that he who runs may read. We are not ready to abandon our established standards of physical diagnosis of active tuberculosis, because in our application of them to certain post-grippal lung conditions we meet with some confusion, and may be led into occasional error in diagnosis. If our regular standards of diagnosis obtain in any given case, they should be considered as con-

clusive unless vitiated by overwhelming counter-evidence. Cautious application, not renunciation, of our proved methods of diagnosis, coupled with watchful waiting, should be our course. The question of active tuberculosis consequent upon influenza is a question of clinical fact, and can only be settled definitely by data obtained from clinicians engaged in tuberculosis work. Health surveys and mortality statistics may well give the incidence of influenza and tuberculosis, but the nexus can only be passed upon by those competent to establish it. A conservative estimate based upon the experiences cited above and gleaned from the literature at home and abroad, and from conversation with many of the leading men of the country engaged in tuberculosis work, leads us to conclude that from 15 to 20 per cent of the new cases of active tuberculosis, presenting themselves since the onset of the influenza epidemic of 1918 to the present time, were caused by the influenza, and that the incidence of active tuberculosis has increased to the same extent during that period and on that account.

The profession should be keenly aroused to this prevailing condition; for truly "the gravity of the situation is not appreciated by the average physician."

The incidence of active tuberculosis consequent upon influenza may vary in certain groups of cases. It may be that this incidence will be found to be less in those who possess great racial resistance or have acquired a higher degree of immunity by virtue of repeated mild activities than in those who, in so far as can be ascertained, have never experienced any activity at all.

We fully agree with the opinion that some of the cases, precipitated into tuberculous activity by the influenza, may have been previously active; that in some the activation may have been coincidental and not interrelated with the attendant grippe; that a few, through mistaken diagnosis, may not have been influenzal at all; nevertheless the preponderance of evidence indicates that most of these cases, having always experienced their usual health prior to the influenza, would, in all probability, have entirely escaped active tuberculosis, had it not been for the epidemic.

Whether we classify some of these cases of previously unrecognized tuberculosis as "healed," because of demonstrable fibrous tissue, is a matter of conjecture, opinion and terminology. The amount of fibrotic tissue demonstrable, however much it may be an index of tissue reaction, cannot be taken as an accurate gauge of preceding disease nor as a

harbinger of increased pulmonary liability. On the contrary, the infection remains latent because it has been circumscribed, englobed or enmeshed with avascular tissue forming an impasse between it, the circulation and tissue juices of the lung, which is safeguarded in direct proportion to the effective emplacement of this tissue. "The patient is as resistant as the shell of his tubercle," says Krause (4). The effectiveness of the capsule depends upon the optimum, not the maximum, development of fibrous tissue, says Bushnell (5). The continuance of latency depends also on two other factors, specific resistance evoked by the infection, and the general well-being of the individual. It is our purpose to endeavor to show that all these defenses are subjected to violent and direct assault by the influenzal affection. An appeal has been made to these fundamental, but established observations, solely for the purpose of laying down for our thesis incontestable and accepted premises from which to deduce our conclusions.

Pulmonary hyperaemia, probably more intense in the vicinity of this inferior tissue, is the method of attack against the protective wall. That influenza, even when uncomplicated by the pneumonias, is frequently accompanied by intense "congestion" of the lungs, is a clinical fact and was completely established roentgenologically by Honeij (6). The large number of cases of latent tuberculosis precipitated into activity, cases which must have withstood for years many severe congestions, suggests the conclusion that the congestion and inflammatory exudations of influenza, more so than other congestions and exudations, even those of ordinary basic lobar and bronchopneumonias, directly tend to overcome the protective barriers. Whether it be that this particular congestive hypertension is mechanically more intense or carries with it to a greater degree quasi-lytic elements or in some way stimulates the incarcerated bacilli to unusual agressive virulence, we do not know; but the conclusion, based on clinical observation, that influenzal pulmonary congestion and exudation are more frequently followed by active tuberculosis than other congestions and exudations, is both reasonable and justified.

The complete disappearance or temporary suppression of the Pirquet reaction in influenza indicates that the reactive mechanism does not function as it did before the attack, and this functioning is usually interpreted as evidence of the presence of an actively working resistance, specific immunity, antibodies, as you choose. Pirquet observed in children that the response by the reacting mechanism to the cutaneous

application of tuberculin, the allergy, previously present, disappeared or was greatly diminished during an attack of measles, thus giving a reasonable explanation of the established fact that active, not infrequently generalized, tuberculosis more often follows measles than the other exanthemata. On account of the temporary abeyance of allergy, measles, in children at least, can be called an anergic disease. Now this condition or status of anergy, or disappearance of allergy, has been shown to be present during an influenzal attack in adults as well, in the same manner and in the same or even to a greater degree, as in measles in children. Debré and Jacquet (7), after a careful review of the work of others and from their own personal investigations, conclude that influenza can awaken active tuberculosis previously latent, and that this phenomenon is intimately bound up in the anergic properties of grippe. They characterize influenza as a "maladie anergisante." Schiff (8) found that out of 64 cases of influenza in children from six to sixteen years of age, 61 gave a negative Pirquet test and concludes that the Pirquet reaction, with few exceptions, results negatively in influenza. The time of its return to normal varies with the individual. It may still be negative in the fourth week the same as in measles.

It is significant to note in this connection that Marquio (9) encountered in one month the unusual number of 23 cases of tuberculous meningitis in children from six months to fifteen years of age, *all of whom had had influenza from a few days to two or three months before.*

Bloomfield and Mateer (10), of the Johns Hopkins Hospital, in 19 consecutive cases of influenza, none of which showed any evidence of tuberculosis, found that only one gave a positive Pirquet reaction; all the rest were negative. Max Berliner (11) found the same diminution of positive Pirquet tests in a large number of adults with influenza, his investigation being prompted in view of the large number of latent lesions stirred up by the grippe.

One investigator, Mueller (12), in verifying Berliner's work, does not wholly agree with him, but concludes that the predisposition to tuberculosis following the grippe is due to the general run down condition, which will also account for the increased number of negative von Pirquet reactions found, according to him, only in complicated influenza.

All this tends to prove that the same lowering of specific resistance to tuberculosis, attending measles in children, accompanies and follows influenza in adults as well. The analogy in this particular is complete; what is true in the one can equally be predicated in the analogue.

These investigations suggest what has been noted before (13), namely. a possible biologic and epidemiologic analogy between measles and influenza.

To the profound prostration that accompanies and follows influenza, all who have experienced an attack will amply testify. Sir Thomas Watson in 1836 characterized grippe as a disease in which "the great subdual of strength is markedly disproportionate to the amount of sickness."

Therefore the local bulwarks of the encapsulated tubercle being definitely attacked in situ, the specific immunity markedly lowered and the general resistance immeasurably subdued, is it astonishing that active tuberculosis should so frequently supervene upon influenza, which so directly attacks and violently assaults each and every defense, that nature has so elaborately constructed against its occurrence?

REFERENCES

(1) Glasgow, W. C.: A septic and unusual form of lung disease existing in the Mississippi Valley during the years 1886 to 1890. Amer. J. M. Sc., March, 1890, 237.
(2) Berghoff, R. S.: Influenza as a factor in the reactivation of quiescent and healed pulmonary tuberculosis. Amer. Rev. Tuberc., 1919, iii, 370.
(3) Tewksbury, W. D.: Pulmonary sequelae following influenza. Ibid., 1919, 375.
(4) Krause, A. K.: The nature of resistance to tuberculosis. Ibid., 1917, i, 65.
(5) Bushnell, G. E.: The treatment of tuberculosis. Ibid., 1918, ii, 259.
(6) Honeij, J. A.: Influenza and bronchopneumonia from a radiological viewpoint. Amer. J. Roentgenol., 1919, 226.
(7) Debré, R. and Jacquet, P.: Grippe and tuberculosis. Grippal anergy and tuberculosis of the adult. Paris Médical, January 3, 1920.
(8) Schiff, R.: The suppression of the cutaneous tuberculin reaction during influenza (Spanish Grippe). Monat. für Kinderheilk., 1918, no. 3, 189.
(9) Marquio, L.: Epidemic and tuberculous meningitis. Revista Medica del Uruguay, Montivideo, December 1919. (Abs. in Jour. A. M. A. March 20, 1920, 831.)
(10) Bloomfield, A. L. and Mateer, J. G.: Changes in skin sensitiveness to tuberculosis during epidemic influenza. Amer. Rev. Tuberc., 1919, iii, 166.
(11) Berliner, M.: The tuberculosis immunity reaction during grippe. Deutsch. med. Wchnschr., February 27, 1919, 238.
(12) Müller, H.: The Pirquet reaction during grippe. Ibid., July 31, 1919, 853.
(13) Ives, G.: The bacteriology of Spanish influenza. Interstate Med. J., xv, 12.

THE SURGEON AND THE CONSUMPTIVE[1]

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It has been the writer's experience that not infrequently active pulmonary tuberculosis is seen in patients who give a history of having recently had an operation, which, in most cases, was done for the relief of conditions which, in themselves, would suggest tuberculosis elsewhere in the body, namely, cervical glands, cold abscesses, tuberculous joints, ischiorectal abscess and fistula, orchitic tuberculosis, tuberculosis of the prostate or kidney, etc.

Further, it has been noted that the history of these cases often contains no mention of pulmonary tuberculosis prior to the operation. But, following operation, for the first time, comes the story of persistent elevation of temperature and increasing cough. It has been our experience that the case progresses (in the wrong direction) some distance before it occurs to the surgeon to seek for his temperature source in the lungs.

The cough has often been attributed to bronchitis incident to anaesthesia, also to having "caught cold." It is the custom, and a proper one, to protect the operated patient from chill, and to prevent the inhalation of cold air. The short period following the operation, when these precautions may be necessary, would in itself be of no great moment in the course of a tuberculosis. But, added to the post-operative period we have an indefinite term of sojourn in a closed room, so that the patient, with a beginning lesion, let us say, is compelled to breathe warmed over and vitiated air to his own undoing. But even this can hardly be held accountable for the rapid pulmonary conflagration which we so often find in these cases. What other factor may we suspect in this connection? What but the anaesthetic?

We note that the class of cases here discussed gives a history of ether anaesthesia, few or none of chloroform administration and absolutely none of local anaesthesia. However, before instituting an attack on

[1] Read before the Chicago Medical Society, January, 1920.

etherization, it might be well to review our knowledge of ether and its effects on the respiratory apparatus. Wood (Therapeutic Principles and Practice, p. 87), says, "Locally, ether is a violent irritant. It is absorbed with rapidity through the mucous membranes both of the lungs and the gastrointestinal tract. When taken, it is eliminated, largely unchanged by the lungs."

On page 108 Wood says, "The existence of severe organic disease of the lungs seems to be a less serious bar to the use of anaesthetics than would be naturally expected. The irritant *local action of ether is an important element* when the lining membrane of the tubes or air vesicles is seriously implicated." "Indeed, our own opinion," says Wood, "is very positive that in some of the deaths which have occurred in persons with diseased kidneys, from oedema of the lungs, directly after etherization, the *cause of death has been the local irritant action* of the ether (italics the author's). In a footnote, p. 108, Wood mentions ether-pneumonia and comments on its frequency. He quotes R. Hoelscher, whose research led him to the conclusion that the pneumonia is really due to the inhalation of bacteria from the mouth into the lung, and that, during etherization, there is practically no irritation of the mucous membrane by ether: further, that the râles heard during narcosis are due to the inhalation of saliva, which may be largely avoided by lowering the head, turning it to one side, and keeping the mouth as free as possible from the secretion. Any mechanical obstacle, according to Hoelscher, greatly increases the likelihood of inspiration of saliva and the consequent danger of pneumonia. Wood considers that Hoelscher's work does not disprove the deleterious effect of the irritant effect of ether.

Again, p. 108, Wood remarks that chloroform should be the anaesthetic of choice in the presence of advanced pulmonary phthisis, extreme emphysema or in chronic bronchitis; also, p. 109, that anaesthetics are especially badly borne when there is acute or subacute pulmonary disease.

Gwathmey (Anaesthesia, 1914, p. 248), says, "In lung and kidney disease, bronchitis, phthisis, etc., patients do better with some other anaesthetic than ether." On p. 185 he says, "It is agreed that ether has a powerful, stimulating effect upon the respiratory system in the earlier stages of its administration. Ether exercises a pronounced irritating effect upon the air passages which gives rise to a free secretion of mucus."

On p. 186, commenting on the result of the experimental narcosis of 25 healthy rabbits, he says, "In seven animals which survived, at most, half an hour in the narcosis, nothing pathological was found, and the vessels contained only normal, undeformed, well stained blood corpuscles. When the narcosis even slightly exceeded half an hour, more or less numerous blue stained granules were found within the vascular lumina, especially in the subpleural small vessels of the lung attached to the vascular walls. The red cells were, for the most part, perfectly normal only in the centre, but deformed, granular and disintegrated toward the vascular wall." As the narcosis continued, further disintegration was seen. These changes occurred chiefly in the fine vessels of the lung.

Gwathmey quotes Mulzer, who regards the blood changes noted in the anaesthesia experiments as due to the circulating ether. Mulzer notes that the number of red cells is considerably diminished after narcosis, while the configuration of the erythrocytes plainly indicates the destructive influence of the narcotic agent (ether).

Gwathmey also says (p. 189), "Because of the stimulating and irritating effects of ether upon the mucous membranes of the upper air passages, trachea and bronchi, there is always a hypersecretion of mucus, which, in some cases, amounts to a mucus inundation. This may give rise to a fatal asphyxia and is, presumably, one of the causes of post-anaesthetic bronchitis and pneumonia."

J. M. Patton, in his Anaesthesia and Anaesthetics (1907), says on p. 104, "Bronchitis, usually mild in degree, is not uncommon after etherization, particularly in predisposed subjects, or after prolonged administration."

Pneumonia is more frequent after etherization than was formerly thought. According to Anders, it amounts to $\frac{1}{3}$ of 1 per cent. "In the lobular pneumonia, caused by ether and which is most frequent, it is likely that the extra secretion of mucus, the interference with the action of the respiratory muscles and the diaphragm, especially in abdominal operations, the pain and coughing, all favor the occurrence of aspiration pneumonia, as suggested by Czerny." None of the authorities consulted trace a connection between the etherization and a subsequent exacerbation of a latent tuberculosis.

It will be noted from a perusal of the foregoing, that the authors cited agree that an excessive flow of saliva or a great mucus flow in the bronchial tract may be produced by the use of ether. It will also be seen that more than one author mentions aspiration of the mucus or salivary secretion.

If, now, an open tuberculosis exists, what could be more easy than that this excessive amount of fluid in the air passages carry with it tubercle bacilli into the deeper reaches of the lung? And, as we rarely find tubercle bacilli in the sputum unaccompanied by streptococci and other bacteria, ought we not expect the fever which so promptly occurs in these cases? We have, also, in addition to the period of etherization, the period of elimination to reckon with. All of us are familiar with the ether-laden breath many hours after operation. Does not the ether continue its deleterious influence during elimination as well as during inhalation? Ether is given off from the blood and exhaled through the lungs. It is not conceivable that the extensive pulmonary involvement found so often after operations where ether is used, especially where the operations are done for tuberculous conditions, should have escaped the eyes of the surgeon, his assistants, or the family physician. The only presumption is, therefore, that an enormous amount of lung was infected by the above mentioned mucus inundation which was bacillus laden.

It must not be forgotten that operations are often performed on tuberculous individuals where the anaesthetic is other than ether. Chloroform has not the same effect on the mucous membrane as ether. Nor is it eliminated through the lungs as is ether. It is decomposed in the system and is excreted in great part through the kidneys. I do not lose sight of its danger to the heart, nor to its possible damage to the liver, from long continued administration. I merely state that its use is not followed by the pulmonary lighting up in the tuberculosis which we so often see. It requires no array of cases to prove the correctness of these premises which will be attested by every worker in tuberculosis.

Recently some attention has been given to the matter of ether anaesthesia by rectal injection. Dufourmental (*Press medicale*, February 10, 1910) concludes from his own experience and that of others, that rectal anaesthesia, for the tuberculous, does not irritate the rectal mucosa. This method, however, does not do away with pulmonary elimination. Further Dufourmental urges the surgeon to use some anaesthetic, other than ether where possible, in the suspected case, to use as little anaesthetic (ether) as possible, and to terminate the operation as soon as possible.

This paper is written to call the attention of the surgeon, (1) to the importance of making, or having made, a careful examination of the

chest in all cases preparatory to operation, (2) to the advisability of deferring operations (where possible) in all cases where the lung findings are suspicious, (3) to the fact that every patient presenting himself for operation for the relief of a tuberculous condition should be suspected of pulmonary tuberculosis until proved beyond question to be free from such disease.

And, in closing, it is urged that acute pulmonary tuberculosis must be recognized as a possible sequel to operation unless the points above adduced are given their true value. On the surgeon, therefore, should be placed the onus of this problem.

SILENCE IN THE TREATMENT OF PULMONARY TUBERCULOSIS

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At practically every meeting of the National Tuberculosis Association the question of rest and exercise in the treatment of pulmonary tuberculosis comes up. While the great majority of phthisiologists recognizes the value of rest, some of our prominent specialists even now claim that bed rest should be used only when the patient's temperature is over 100.5°F. Luckily, I believe, this view is not generally held; if it were the treatment of pulmonary tuberculosis would be put back more than a score of years. However, even those who appreciate the value of rest, differ considerably as to the intensity and the duration of its application.

The historical, experimental and clinical foundation for the use of absolute rest has been well summarized in the papers of Kinghorn (1), Bushnell (2), Pratt (3) and in a previous paper by myself (4), but it would seem well to quote here some of the results of these experimental data. Krause (5) claims that a person's resistance to tuberculosis is that person's power to form scar tissue around a tuberculous focus of such density and completeness that the focus is entirely cut off from the circulatory system. If this be correct—and Krause has brought very effective arguments and proofs in favor of it—the researches of Tendeloo (6) point out the rationale of rest. He has shown that a chemical irritant injected into normal lung tissue produces a central necrosis, surrounded by areas of different degrees of inflammation, and outside these a zone of scar tissue formation. In tuberculosis, scar tissue is likewise formed by the reaction of the lung to the irritation of the toxins of the bacilli. These toxins cause the most efficient formation of scar tissue at a certain optimum distance; if the parts are constantly moving the optimum distance will be distributed over a greater area of tissue, but since it is not concentrated at any given point, the scar tissue formation will be diffuse, but less effective and less complete. Therefore, the quieter the lungs are kept, the more efficient and more localized will be the scar tissue formed.

Tendeloo has also emphasized the fact that the diseased portion of the lung contains more lymph and expands less than the surrounding healthy lung, and he believes that the tuberculous process in the lung is spread by the aspiration of lymph from the diseased focus which presumably contains tubercle bacilli and toxins. If the lung is brought to complete rest, the flow of lymph through the tuberculous focus is very much diminished, with a consequent decrease of nutritive substances to the diseased area and the accumulation therein of tuberculous toxins which definitely retards the growth of the bacilli.

According to Tendeloo, also, the respiratory changes in volume of the lung are least in its suprathoracic and paravertebral sections; that is, the apical and hilum portion of the lungs move less than the basal and peripheral portions. And it is a well known clinical fact that a lesion in the base of the lung is much more serious and heals much more slowly than one located elsewhere.

With clinical experience supporting these ideas, the use of bed rest has increased tremendously in the last few years and with its use the results are becoming more favorable. But for certain patients even absolute bed rest, with or without postural treatment, is not sufficient; and unless they are able to take artificial pneumothorax or willing to submit to an extrapleural thorocoplastic operation, they seem doomed. Of course, there are many cases who, on account of a bilateral lesion or adhesions on the diseased side, are unsuitable for pneumothorax or unwilling to be operated upon. In trying to find some means further to immobilize the lungs of these patients I remembered several patients with an involvement of the larynx who had not been allowed to talk for several months, and whose pulmonary condition during this time showed greater improvement than it had before or since. It occurred to me that it was not necessary to have a laryngeal involvement in order to put a patient on the "silent bed cure." *A priori* this method should prove of value in the treatment of individuals of several classes:

1. Patients with pulmonary lesions who have not made satisfactory progress on the ordinary regimen of rest and who are unsuitable for operative procedures.

2. The alert talkative patient who although in bed exercises his lungs more than he would in walking a short distance.

3. The nervous excitable patient in whom conversation is most apt to upset his central nervous system already impaired by the tuberculous toxin.

With these ideas in mind, this treatment was tried on several moderately advanced and far advanced cases with results which indicate the wisdom, even the need, of paying more attention to restricting the amount of talking in which patients are allowed to indulge.

The results in some of these cases are most striking. One patient, a school teacher, had been in bed for three months with no improvement. Almost immediately after she was put on absolute silence her temperature became lower and she improved in every way. Probably a more striking illustration is that of a graduate nurse who recently came from Illinois with far advanced disease. She began to improve almost at once. Then, in order to reduce expenses, she moved to a porch with another young lady. Although she had been warned to talk as little as possible she at once grew worse; her fever became higher, cough and expectoration increased, and the night sweats which she had not had since the first two nights after her arrival, returned. After a couple of weeks she was again moved back to a single porch and the change in her condition was immediate and marked. This tendency to talk seems to me to be the great drawback to the ward and leanto system in the treatment of pulmonary tuberculosis.

All patients when first seen are warned against excessive talking. If the examination indicates a critical condition, or if after a fair trial of absolute rest in bed there is no improvement, the patient is advised to stop talking and to use a pad and pencil to make known his wants. It is often surprising to see how very soon the temperature and pulse assume a lower level, and the general condition of the patient improves. As soon as the temperature has reached normal and remained so for two or three weeks, the patient is allowed to talk for five minutes a day, and this time is very gradually increased as the patient's condition warrants.

Our patients who do least well, and in whom this silent treatment is most often indicated, are those with lesions involving the base of the lung. According to Tendeloo the base moves more than any other part. Most people use abdominal breathing in talking, and it is apparent that the basal portion of the lungs are expanded much more in talking than in quiet breathing. I have tried to find tables showing how much more work the lungs do in talking than when at rest, but have been unable to do so. However, that such is the case—both an increase in rate and in degree of expansion—must be evident to any one. In looking up the literature I have been able to find only two references as to the value of silence, namely an article by E. E. Prest in the London

Lancet of April 3, 1909, and one by C. Q. Thompson in the *Southern Medical Journal*, February, 1919.

The great objection to the use of silence is its effect on the mental condition. On the other hand, the advantage of silence is not solely due to the localized effect on the lung but also to the lessening of general bodily fatigue and the absence of mental excitement. The treatment requires the most careful supervision and encouragement of the patient by the physician; but if the physician has the absolute confidence of the patient, with the judicious use of psychotherapy and the improvement in the patient's condition apparent to him, the mental attitude will improve along with the physical condition.

REFERENCES

(1) Kinghorn, H. M.: Rest and exercise in pulmonary tuberculosis. Amer. Rev. Tuberc., 1919, iii, 210.

(2) Bushnell, G. E.: The treatment of pulmonary tuberculosis. Ibid., 1918, ii, 259.

(3) Pratt, J. H.: The importance of prolonged bed rest in the treatment of pulmonary tuberculosis. Ibid., 1919, ii, 637.

(4) Schaefer, S. W.: Absolute rest in the treatment of pulmonary tuberculosis. Colorado Med., 1919.

(5) Krause, A. K.: The nature of resistance to tuberculosis. Amer. Rev. Tuberc., 1917, i, 65.

(6) Tendeloo, N. P.: Pathologische Anatomie, in Brauer, Blumenfeld and Schroeder's Handbuch der Tuberkulose. Johann Ambrosius Barth, Leipzig, 1914, vol. i.

(7) Tendeloo, N. P.: Beitr. z. Klin. d. Tuberk., 1908, xi, 229.

FEW PRISONERS WITH TUBERCULOSIS IN MASSACHUSETTS PRISONS

This summer, Sanford Bates, the Commissioner of the Department of Correction, of the State of Massachusetts, secured the coöperation of the Department of Public Health, Division of Tuberculosis, for the purpose of examining the inmates of all the prisons in the State of Massachusetts.

Tuberculosis experts from the four State tuberculosis sanatoria, under the direction of Dr. William J. Gallivan, Director of the Division of Tuberculosis, examined all of the inmates, 1571 in number, in fourteen of the state and county prisons. The population of these prisons ranged from 5 to 510 each.

The result of this examination has just been announced and is a remarkable showing. Only 7 out of the 1571 prisoners were found to have active tuberculosis, one healed and 52 under observation. These seven active cases were transferred promptly to the prison hospital for treatment.

It is interesting to note that none of these active cases was found in the state institutions. They were all in the county institutions.

The inmates of the Reformatory for Women and the Bridgewater State Farm were not examined as these institutions have consumptive colonies.

The inmates in two of the Houses of Correction were not examined as it was not desired by those in charge. The balance of the Houses of Correction, not mentioned in the 14, were closed.

S. H. Stone,
Secretary Boston Tuberculosis Association.

August 12, 1920.

STUDIES ON IMMUNITY TO TUBERCULOSIS

A DESCRIPTION OF GRAPHIC RECORDS OF THE LOCAL ALLERGIC AND IMMUNE REACTIONS TO TUBERCULOUS REINFECTION IN GUINEA PIGS

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From the Kenneth Dows Fund for the Study of Tuberculosis, of the Medical Clinic of the Johns Hopkins Hospital and University

The essence of the Koch phenomenon is *a rapid ulceration followed by a slough and healing wound at the point of reinoculation* of tubercle bacilli. To this sequence of events, and this only, should the term be applied. Inasmuch as animals in which the phenomenon occurred were observed to contract relatively little or no tuberculosis in consequence of their reinoculation, it was supposed that the phenomenon was a manifestation of immunity. This conception is undoubtedly correct.

Early writers believed that the nonprogression of lesion, due to reinoculated bacilli, occurred because the latter were completely evacuated by the slough. To this view later observers, like Besançon and Serbonnes (1) adhere. However, no student, who has to any large extent practised reinoculation on guinea pigs, can have failed to notice that under certain circumstances reinfection need not be accompanied by sloughing, yet immunity in such animals proves to be undoubtedly high. In these instances the failure of the reinfection to progress obviously cannot be due to an elimination of bacilli by sloughing.

Several years ago Rist and Rolland (2) gave it as their experience that reinoculation of the guinea pig's skin could be followed by one or another of three different types of lesion, namely, (1) the phenomenon of Koch, (2) an ecchymotic oedema terminating in a chancriform ulceration, and (3) lesions which were similar to those of a primary infection except that they appeared earlier and developed more rapidly than the latter. Our own experience would not lead us to separate sharply all the possible grades of reaction to reinfection into three different types. We believe that there may occur every shade from the most transient

and slight inflammation to one that is most violent, and rapidly necrotizing and hemorrhagic. In a long experience we have observed the skin reaction to reinfection run this entire scale.

With the recognition of cutaneous allergy those who were familiar with tuberculo-immunology were not slow to appreciate it as the motive force behind the Koch phenomenon. In their memoire Rist and Rolland assimilate the two. As a matter of fact, the local skin manifestations can be obtained without the application of *tubercle bacilli* to the skin. Necrosis, ulceration and slough may follow the introduction of *tuberculin* if the dose is large enough and the animal is hypersensitive enough. One of us has observed this intense result not infrequently in guinea pigs and twice in human beings.

Dosage of antigen plus degree of hypersensitiveness determine the character—the rapidity, the vigor, the ultimate effects—of the allergic skin reaction to tuberculin (3). And the same factors influence the skin reaction to the application of tubercle bacilli.

To-day every physician is familiar with the phenomenon of cutaneous allergy, as expressed in the inflammatory response to the superficial application of tuberculin, à la Pirquet, in a tuberculously *infected* individual. He recognizes that because of some tuberculous focus, manifest or concealed, the latter's tissues have acquired a new reacting capacity to a *product* of the bacilli. Most physicians are also aware that all existing tuberculous infection raises an individual's resistance to reinfection. But, although not a little has been written on the subject, it is questionable whether, except among those who are engaged in experimental work in tuberculosis, it is widely appreciated how intimately allergic phenomena enter into the series of events that follow the application of *tubercle bacilli* to tuberculous animals. Nor, so far as we know, has it been made plain where, under the circumstances, allergy begins and where it ends, or whether it is or is not the entire mechanism of immunity. Written descriptions have their limitations in conveying information to the reader, lacking, as they do, the power to present at a glance a complicated series of events which may have taken weeks to evolve. For this reason we have been led to analyze local allergy and immunity to tuberculous reinfection from a series of graphic representations which would permanently and vividly fix, as it were, our observations, and permit of comparisons which no literary descriptions would allow.

The purpose of this communication, therefore, is to bring to the physician's attention the phenomena of local allergy and immunity to tuberculosis in a more living way and to discuss the several important features that these illustrations present.

The plates depict accurately, as to size, color and conformation, various consecutive stages of the development of local reactions to tubercle bacilli throughout a period of nine weeks. All the reactions illustrate the results of inoculations of the same dosages of the same emulsion of living tubercle bacilli at the same time; and, in general, whatever variations of lesion may appear between the several animals concerned must be ascribed to basic differences in the recipients of the infection. It must be remembered, however, that perfect equality of dosage of living tubercle bacilli must always remain an impossibility, even in exactly equal quantities of the same suspension. Certain physical attributes of the bacilli forbid it, and even though we made up our several inoculating amounts by carefully picking out bacilli, one by one, from a given suspension, we could never be certain as to how many were alive and how many dead. Whenever we speak of equal dosage, therefore, we mean parity within certain limits which are never more than vaguely definable. However, we can always "absorb" much of this unavoidable technical error by making our observations on large series of animals; when, if a comparison between several series discloses uniform results in one series that differ from uniform results in another, and if our dosages were equal quantities of the same suspension, we can look upon the latter as the constant and the animals as the variables.

In the case of these particular inoculations we used two series of ten animals each, and the results in each were strikingly uniform with one minor exception which will be noted later. If we wish to observe allergy and immunity unfold themselves at their best we must be careful not to overdose our animals. With large numbers of bacilli applied to a highly hypersensitive animal we are bound to get the violent Koch phenomenon, in which all the finer evolutionary details of the hypersensitive reaction are obscured by the extraordinarily rapid and intense progression of events. If, on the other hand, we use minimal quantities the reaction will be only slightly detectable, or not at all, or will not proceed to completion. The reactions, here figured, represent responses to dosages that we have been accustomed to use for years in studies of this nature, that is, several hundred bacilli. With the reservations just mentioned, the actual numbers or weights of bacilli are not as

important as is the employment of a technique which will assure as nearly as possible the same dosage to all animals under observation. We believe that given amounts of a *very dilute* suspension will approach equality of bacillary content far more closely than will equal weights of cultures.

DESCRIPTION OF THE PLATES

The plates illustrate the course of events at one day after intracutaneous inoculation of virulent bacilli and then weekly from one to nine weeks. No one day drawings were made of animal *C*, plate 1 and animal *A*, plate 2.

Plate 1 depicts the development of skin lesion in three guinea pigs, *A*, *B* and *C*, which were normal (nontuberculous) at the time of infection. It therefore represents the sequence of phenomena after *primary* infection.

Plate 2 figures the evolution of local effects in four guinea pigs, *A*, *B*, *C*, and *D*, which were already tuberculous[1] at the time of skin infection. It therefore represents the results of *reinfection*.

Merely a cursory glance at the two plates will at once bring out the following sharp points of contrast:

1. An immediate reaction on the part of the tuberculous animals which is absent in the normals.

2. An early development of nodule in the former which is again lacking or less well defined in the controls at this time (one week).

3. A tendency of the lesions in the tuberculous soon to come to a standstill, while at the same time (two weeks) those in the controls are now rapidly developing.

4. A later tendency of lesion in the tuberculous animals to retrogress and heal, while that in the controls persists and progresses.

It will be convenient to discuss the several points of differences under the above four heads.

1. The immediate reaction in the tuberculous animals. This is inflammatory, pure and simple, and has nothing of a *tuberculous* nature about it. It is cutaneous allergy, a protein phenomenon, met with only in an animal with tubercle and resembles in every respect what happens when tuberculin is similarly injected into a tuberculous animal. Like the tuberculin reaction it is transitory. In animals *B*, *C*, and *D*, here de-

[1] For details of infection, etc., of both series of animals, see paper immediately following this: The Results of Virulent Reinfection into Tuberculin-Reacting Areas (Skin) of Tuberculous Guinea Pigs, p. 563.

picted, all traces of it had disappeared by the end of four days. It does not represent the normal reaction of tissues to living tubercle bacilli: this latter is shown in plate 1 where it will be seen that tubercle, a nodule, the normal reaction, develops out of a noninflamed background. In the tuberculous animal, however, where bacilli are anywhere reimplanted, fresh tubercle, when it results, arises in soil that has been recently inflamed, and no one who is accustomed to watch this invariable inflammatory result of reinfection (invariable when dosage is sufficient and allergy is present), can help being impressed by the probability that this initial inflammation plays a large part in the turn of subsequent events,—in the immunity which later developments show as having existed.

It cannot be too strongly brought out that this early inflammation rapidly subsides. Practically every description of the Koch phenomenon and its modifications conveys the impression that the result of reinoculation of living bacilli is an uninterrupted progression of events from beginning inflammation, oedema, etc., to culmination in an ulcerating nodule which is nonprogressive or a sloughing ulcer which later heals. This is true only when dosage is excessive, and events follow so rapidly that they overlap, and the several component features of the reaction cannot be differentiated one from another.

The initial inflammation, unless dosage is too great, always clears up soon. And if both dosage and allergy are just "right" it may occur that *for a short interval—a day or two or three—the skin again appears perfectly normal to the naked eye*, before we begin to observe the dawning of the second stage of the reaction. We unfortunately neglected to make drawings of the sites of inoculation between the first day and the first week. But we have notes which record that three days after inoculation there was no abnormality of any kind detectable in animal *C* of plate 2, and for a day this state of affairs continued. It also occurred in several other animals of the 10 which were reinfected and of which the 4 shown on plate 2 are representative.

Of plate 1 at this stage little need be said except that it brings out more sharply and clearly than pages of description that, unless dosage is enormous, *the primary introduction of living tubercle bacilli causes no early, grossly visible effect at the site of inoculation (or elsewhere)*. The slight changes in the skin noted at one day are purely traumatic, due to wounding by the needle the day before. If we are to understand the pathology and therefore the symptomatology of tuberculosis, it

is all important that we grasp this basic fact,—*reaction to primary infection is sluggish and at first does not affect the animal that has just been made tuberculous.*

2. The accelerated development of nodular tubercle in the tuberculous animal. The outstanding feature of the allergic reaction is inflammation; and most treatises of the subject have confined themselves to this component. By inflammation we mean that biological process which is initiated by an outpouring of exudative elements of the body and in which the fluids and wandering cells of the body participate. An inflammation is, of course, not completed without the synchronous or later proliferation of cells of the connective tissue type which limit the exudation and promote repair of the traumatized part. But practically every observer of allergy has paid attention to only the exudative phenomena of allergy and one can search the literature in vain for any mention of the participation of fixed tissue cells in it.

Plate 2 brings out plainly that there is more to the changed reaction to tubercle bacilli and their products, conferred by an initial infection, than an exaltation of the tissues' capacities to respond exudatively. *Nodular tubercle, made up largely of epithelioid, fixed tissue cells, the normal anatomic response to tuberculo-bacillary irritation, also manifests itself much earlier.* In other words the fixed tissue cells are also "sensitized" by the presence of tuberculous foci. And that they must be "sensitized" to a considerable degree the following considerations will show.

Work that has been done to demonstrate satisfactorily the method of disposal of bacilli at the site of inoculation has thus far been slight. But the little that has been reported points to the great probability that they are very rapidly destroyed *in situ* by some factor that accompanies the exudative reaction (2), (3), (4). Until an exact explanation of immunity is forthcoming, we must assume that it is this almost immediate destruction of bacilli, leaving as it does comparatively few to exert their pathogenic effects on the body, that to some extent, at least, accounts for the immunity observed. We are no doubt correct in assuming, therefore, that subsequent lesion in the tuberculous immunes (for some lesion, however slight, always occurs) proceeds from smaller numbers of bacilli than does lesion in controls, in which more survive the primary inoculation.

Now the *tubercular* reaction to *primary* infection is comparatively slow in coming to light. But it has long been observed by all that its rapidity of development is directly proportional to the size of the infect-

ing dose: massive primary infections will arouse visible tubercle much earlier than will very minute ones.

Yet in tuberculous (and therefore allergic and immune) animals real nodular tubercle develops more rapidly to what must be relatively few surviving bacilli than to large numbers of bacilli in the primarily infected (and therefore non-allergic and nonimmune) animals. These facts stand out plainly, and, because of them we have no other recourse than to infer that *the reacting capacity of the fixed tissue cells has also been altered by the preëxisting infection—altered in such a way that it is greatly enhanced:* for it is these cells which are the most prominent constituent of anatomic tubercle and which by their proliferation eventuate in anatomic tubercle.

No pathologist doubts that anatomic tubercle is by reason of its very structure a conservative and protective formation, tending to confine and hinder the activities of the interned bacilli. And few will dispute that *ceteris paribus* the more rapidly tubercle formation is evolved in response to the irritation of bacilli, the greater will be the degree of protection afforded. If for no other reason than because it would tend to prevent rapid dissemination of bacilli, an earlier development of tubercle would bring about an enhanced resistance to bacillary invasion of the body.

We would submit, therefore, that granted that, as Rist and Rolland suppose, a bacteriolysis accompanies the manifestation of allergic exudation at the site of infection and that immunity to reinfection is thus accomplished, *the accelerated development of tubercle also plays its part in the mechanism of immunity.*

Plate 2 shows that one week after reinoculation there is no sign of acute inflammation, but that nodules exist in all the animals. This was true for all nine guinea pigs of the series. The nodules began to appear four days after infection. At five days all animals showed small, red nodules, averaging 3 x 3 mm. in diameter. Two days later they had developed to the extent shown in the figures.

Meanwhile, with one exception, none of the animals shown on plate 1 exhibited the slightest visible change at the end of a week. All that was then seen was the faintest linear trace of the needle track. Between the end of the first and second weeks, however, nodules rapidly developed —to such an extent, indeed, that at the latter time they were for the most part larger than in the immune animals: and, while most of the latter were as yet still firm, most of the former were beginning to soften and show evidences of early ulceration.

Within the next (the third) week, all of the nodules in the controls did ulcerate, while ulceration in the allergic animals, when it occurred, was always later than in the controls.

We would call attention to the fact that in the controls the nodule originates in a noninflamed base, differing in this particular from what occurs in the allergic guinea pigs.

We would also direct attention to the course of events in animal *B* of plate 1. This was the only one of 10 controls in which nodular lesion began to appear by the end of the first week. It is quite likely that this animal received more bacilli in its 0.1 cc. of the suspension than did the others, and that, therefore, lesion occurred a little earlier than usual. If one were to leave out of consideration the immediate allergic inflammatory response which is never seen after primary infection, then one would be tempted to affirm that the higher we go in primarily infecting doses the more likely, in other respects, we are to bring about a series of local effects that approaches what obtains upon reinfection—with, however, the very important reservation that the allergic animal will exhibit an immunity to progressive infection while a normal animal will succumb the more rapidly to the larger doses.

It would seem as though all susceptible animals possess their own definite and peculiar normal reacting capacity to tubercle bacilli; a capacity which is quite uniform for a species and which consists, in one respect, in a given irritability of the body's fixed tissue cells to bacillary stimulation. These cells will react more vigorously and more extensively to large first infections than to small ones. But infection "trains" or "sensitizes" these cells (in our present ignorance of underlying factors it is hard to find more accurate words), so that their irritability now becomes greatly enhanced. When, therefore, reinfections occur these cells react even to very small ones with the speed and vigor that once characterized their response to very large first infections. The immediate inflammatory reaction is a new attribute—one that is foreign to the normal, nontuberculous animal, although it is true that when dosage of tubercle bacilli is enormous a rapid outpouring of serum and polymorphonuclear elements follows it. But this is an altogether different thing from the inflammation of allergy as observation and experiment will show. It is a response to the large amount of protein represented by excessive numbers of bacilli and comparable to the second outpouring of polymorphonuclear leucocytes which later attends the rapid disintegration of caseous tissue and the formation of pus. It comes on rapidly and it disappears just as rapidly.

3. The abortive development of lesions in the allergic animals. It will be observed on plate 2 that in originally tuberculous guinea pigs local lesion does not develop much beyond the limits set by the end of the second week. In animal *C* the tendency is wholly retrogressive after this period. In animal *A* it maintains practically the same level from one week to five weeks when slight ulceration occurs: and almost the same conditions obtain in animal *B*. In animal *D* there is comparatively early ulceration which, however, does not progress much: but it will be noted that in this animal the point of inoculation suffered the most intense allergic inflammation and that slight necrosis and even haemorrhage accompanied the latter. It is quite likely that this weakened area of epithelium at the centre formed the nidus of a subsequently early ulceration.

All the local lesions in the controls continue to progress meanwhile. At three weeks a new nodule is developing in the lower pole of the lesion in animal *A* of plate 1, and during the succeeding weeks it becomes larger and larger. It must be remembered that by the end of two weeks—and even earlier—the controls have become sensitized by their primary infection; and that any fresh extension will thereafter take place in allergic soil. In other words, after two weeks the controls approach the condition of the reinfected at the time of reinfection. What happens, therefore, is a new nodular formation in the controls, and these new nodules will not ulcerate like the primary ones unless dosage is again excessive. In all 10 controls there was a very sluggish extension of infection in the peripheries of the original lesion, as represented by the development of nodules, but in none did ulceration occur. In one of the controls, which is not figured on the plate, there occurred a widespread dissemination of tubercles throughout the skin of the entire side, with consequent development of enormous inguinal and axillary buboes, yet none of these secondary nodules ulcerated.[2]

4. The retrogression and healing of lesions in the allergic animals. As regards the course of events after the fourth week, little remains to be said except that in general the lesions in the allergic animals tend to heal, while those in the controls persist as open ulcers with greater and greater induration of their edges, or tend to extend very slowly. Nevertheless, one or two significant points may be here touched upon.

[2] A drawing of this unusual result of intracutaneous infection accompanies the paper, Studies on Tuberculous Infection. VII. Some Factors that Influence the Development of Tubercle in the Lymph Nodes of the Guinea Pig, Amer. Rev. Tuberc., 1920, iv, 193.

In the main, the local lesions in the controls tend to remain localized. They have reached a certain size and afterwards increase this but very indolently, if at all.

The early tubercle in them was delayed; but once initiated it proceeded rapidly until it established a good degree of allergy. Meanwhile, during its comparatively dormant period bacilli could develop and spread widely because no anatomic barrier like tubercle impeded their passage. This failure of early focalization and localization of bacilli is demonstrated by the rapid palpable involvement of the regionary inguinal nodes in the controls and the extent which this attains. With the acquirement of allergy the local focus ceases its rapid growth: the surrounding tissue is now more competent to resist extension of infection, in that it reacts much more rapidly and vigorously to endogenous reinfection. However, the local lesion in a primarily infected animal is one that has always had comparatively large numbers of bacilli to cope with, and if the initial dose was large enough it never completely overcomes them. While at the centre its tissue may become necrotic and some bacilli may be cast off by sloughing, its edges always harbor bacilli which perhaps set up nodules here or may be conveyed to regionary nodes to add to the infection there.

In the originally tuberculous animals, however, many bacilli are destroyed very soon after reinfection. The rapidly developing tubercle tends to restrain the few that survive the first inflammatory reaction. The failure of the regionary nodes to show involvement, or their relatively slight involvement, proves how well early localization and focalization are accomplished.

Yet the bacilli are very tenacious of life and a few, a very few no doubt, usually remain for a long time in these reinfection lesions. The latter can as a rule take care of these, yet it is remarkable how frequently they will fail in completely eradicating the bacilli: and it was because of this latter circumstance that Römer, by reason of his own and of Hamburger's observations, believed that in allergic animals the bacilli remained intact in tissues, yet deprived of their normal inherent power to act on the latter. It is more than likely, however, that the varied interrelations and interactions of allergy and infection—of the action of the former on the latter and of the latter on the former, of the consequent alternating phases of anergy and allergy, etc.—a remarkably broad and complex phase of the subject of tuberculo-immunity, which we cannot enter upon here, would explain these apparent paradoxes

and contradictions. In the present instance we must follow only a direct and clearly defined path and lay bare the sharper features of allergy.

By way of conclusion, and with these plates of the local lesions before us, we may profitably point out the ultimate effects of the virulent inoculations in the animals figured. At the end of nine weeks, on the day the last drawings were made, the animals were autopsied with the following results:

Animal A, *plate 1*, had advanced tuberculosis of the regionary inguinal lymph nodes, moderate involvement of the regionary axillary nodes, and very advanced tuberculosis of the liver and lungs.

Animal B, *plate 1*, had a similar condition of the inguinal and axillary nodes and spleen but no gross involvement of the liver and lungs.

Animal C, *plate 1*, had a similar condition of the regionary nodes, advanced tuberculosis of the spleen, slight tuberculosis of the lungs, and no gross lesion in the liver.

Animal A, *plate 2*, was without appreciable lesion in regionary nodes or any viscus.

Animal B, *plate 2*, had very slight involvement of the inguinal nodes but was without lesion in the axillary nodes, spleen, liver and lungs.

Animal C, *plate 2*, showed changes identical to those in *B*.

Animal D, *plate 2*, had no definite involvement of the inguinal nodes, liver and lungs; but there was slight lesion of the axillary nodes and one small tubercle in the spleen.

REFERENCES

(1) Bezançon, F., and de Serbonnes, H.: Superinfection tuberculeuse expérimental du cobaye. Annal d. Méd., 1914, i, 129.

(2) Rist, E., and Rolland, J.: Étude sur la réinfection tuberculeuse. Troisième mémoire. La réinfection cutanée at le phénomène de Koch. Ibid., 1914, ii, 13.

(3) Paterson, R. C.: The pleural reaction to inoculation with tubercle bacilli in vaccinated and normal guinea pigs. Amer. Rev. Tuberc., 1917, i, 353.

(4) Soper, W. B.: Experimental tuberculosis of the liver. Ibid., 1917, i, 385.

EXPLANATION OF PLATES

Plate 1 presents the development of local lesions in 3 animals, *A*, *B*, and *C*, which were *primarily* infected in the skin (intracutaneously) with virulent, living human tubercle bacilli. At the time of infection the animals were nontuberculous and normal. On the left-hand margin of the plate are indicated the intervals after infection at which the drawings were made. The outstanding features of these first infections are (1) the absence of any immediate reaction, (2) the sluggish development of tubercle and (3) the progressive course of the tubercles after they come to view.

Plate 2 shows the response to virulent infection in 4 guinea pigs, *A*, *B*, *C*, and *D*, which received *reinfection* intracutaneously. These animals had previously been inoculated with human tubercle bacilli of low virulence, infections which served to render them allergic and immune. A type of anatomic reaction which is fundamentally different and which runs a different course from that depicted on plate 1 is plainly brought out. In contrast to the latter there is here observed (1) a rapid, acute inflammation, (2) an accelerated development of nodule (tubercle) and (3) a tendency of the lesion to reach its fullest development soon and then retrogress.

All these features are discussed in more detail in the text.

For description of figures see text

For description of figures see text

STUDIES ON IMMUNITY TO TUBERCULOSIS

THE RESULTS OF VIRULENT REINFECTION INTO TUBERCULIN-REACTING AREAS (SKIN) OF TUBERCULOUS GUINEA PIGS

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The experiments which we are about to describe originated in the desire to study the part played by inflammation in hindering or abetting tuberculous infection. As is well known, inflammatory or exudative phenomena are prominent accompaniments of the reaction by which the cutaneous or allergic state manifests itself. The reasons that would lead one to suppose that, altogether apart from the unknown forces at work in the production of the allergic reaction, the resulting inflammation of itself has an infection-resisting influence have been presented at length in other communications (1), (2), (3), (4), (5).

The idea that inflammation under certain conditions tends to prevent tuberculous infection grew out of an exhaustive study of the cutaneous reaction to tuberculo-protein in guinea pigs (2). From this it was but a step to assume that if it were true that the skin of a tuberculous animal resists intracutaneous infection because of the inflammation set up at the site of reinfection by the application of tubercle bacilli to hypersensitive soil, it should be likewise true that a similar, though nonspecific, inflammation in a normal, nontuberculous animal would also impede infection.

Acting upon this presumption, one of us, throughout a period of several years, attempted to bring about, by nonspecific methods, physical changes in the skins of normal guinea pigs that would resemble those met with in the well known cutaneous tuberculin reaction; to the end that inoculation of tubercle bacilli might be made into such inflamed areas and the course of infection compared with that which follows simlar inoculation into normal skin of normal animals. Various media were tried in these attempts to injure the skin—heat, bruising, cantharides, needling, etc.; but the experiment has been temporarily abandoned

because of an inability to produce an inflammation, the physical extent and character of which were at all comparable to those of the inflammation of the tuberculin skin reaction. Some of the irritants blistered the skin; others produced only superficial changes without blistering; still others were too violent: none brought about that even congestion and oedema of the entire cutis, with perhaps some central pallor or necrosis, which are characteristic of the skin reaction; and, under the circumstances, infection of the inflamed areas was never performed. Radium or the X-rays were never used, because of the possible criticism that besides inflammation of the skin they might produce constitutional effects in the animals. Neither were sterilizing chemical agents, such as alcohol, turpentine, iodine, etc. applied; there might arise a reasonable margin of criticism that such bactericidal substances killed bacilli and in this way influenced infection.

The problem in outline was (1) how to get a skin inflammation that would resemble as closely as possible that of an intracutaneous reaction, and (2), once this was obtained, how it would influence infection performed directly into it.

After the above-noted early preliminary failures to induce the right kind of inflammation, it occurred to us that we might gain some of the information we sought if we made our inoculations of living tubercle bacilli into areas of the skin which were undergoing various stages of tuberculin reaction. There could then, at any rate, be no question that we were starting with an unobjectionable type of inflammation. We would, of course, be obliged to work with tuberculous animals, which by reason of a primary infection were already immune as well as allergic; but tuberculo-immunity at best is a relative immunity, with many shades and degrees of variation, and it was reasonable to presume that animals infected in the manner intended would exhibit a different behavior toward infection when compared with control tuberculous animals whose normal, nonreacting skin had been similarly reinfected. We were aware also that the result might be confused because the tuberculin skin test, before reinfection, might have a more deep seated effect on the animals than the production of a simple inflammation; yet it did not appear likely that the small amount of tuberculin employed in the test, an amount that would apparently be much less than that necessary to induce a constitutional reaction, would produce effects that would seriously interfere with a proper interpretation of whatever results might occur.

The experiment was accordingly performed in four stages, as follows:

1. Preparation of animals by infecting and thus sensitizing them.
2. The production of skin inflammations by the intracutaneous application of tuberculo-protein.
3. Reinfection with living tubercle bacilli into the inflamed areas.
4. Observation and estimation of the final results at autopsy.

The fact that reinfection was made in the skin furnished the opportunity to observe and record closely the development and course of local lesion at the site of inoculation, an opportunity of which we availed ourselves fully. For a week after reinfection the condition of the animals was noted in detail almost daily; and after this period, at least once a week for nine weeks after reinfection. We thus accumulated a large mass of data, much of which had a bearing on one or two other phases of immunity and infection which we had not anticipated. The main problem which we set out to investigate was not solved; but there were disclosed several features of infection which to us appear to be of as great importance.

THE EXPERIMENT IN DETAIL

1. Preparation of animals. On September 26, 1919, seventy normal, full-grown guinea pigs, of an average weight of from 300 to 500 grams, were inoculated, each subcutaneously in the right groin, with 0.5 cc. of a heavy suspension of a vigorously growing glycerine-agar culture (three weeks old) of living human tubercle bacilli of low virulence. The culture was of the R 1 strain, Saranac Laboratory. Its infecting capacity for guinea pigs has been fully described in another communication (6), to which the reader is referred. Under the ordinary conditions of a single subcutaneous infection into the groin it brings about a macroscopic tuberculosis that is confined to the lymphatic system and never appears in the viscera. The sensitizing and immunizing results of such infection have also been recorded elsewhere (2), (7), (8), (9).

During a period of almost six weeks, while infection was developing in these animals, cutaneous sensitiveness to tuberculin was tested from time to time on several individuals of the series. We desired to make our tuberculin injections at a time when there could hardly be any doubt that all animals were uniformly and highly hypersensitive. Before and during this preliminary period too, in order to be certain of its infecting capacity, we intracutaneously inoculated several normal guinea pigs

with varying doses of the virulent tubercle bacillus that was to be used later for reinfection. In this way we could become familiar with its infectiousness at the time of the experiment.

2. *The production of skin inflammations.* Of the 70 infected guinea pigs, 4 died during the first few weeks after primary infection; and 57 of those remaining were used for reinfection into tuberculin-reacting areas. The remaining 9 were used as tuberculous controls for reinfection, that is, in them reinfection was to be performed into skin that had not undergone tuberculin reaction.

The 57, above named, were then divided into three separate lots as follows:

Lot 1: Comprising 18 survivors of the 20 originally numbered 1 to 10 and 31 to 40.

Lot 2: Comprising 20 animals numbered 11 to 20 and 41 to 50.

Lot 3: Comprising 19 survivors of the 20 originally numbered 21 to 30 and 51 to 60.

These three lots were then prepared for reinfection as follows:

Lot 1: On November 1, 1919, or thirty-five days after primary R 1 infection, 8 of them (nos. 1, 3, 4, 5, 6, 7, 8 and 10) were injected intracutaneously with W. E, in the skin of the left side, which was the side opposite to the local (right groin) tuberculous lesion, and 10 (nos. 31 to 40 inclusive) in the skin of the right side, or the same side as the original infection. The W. E. was a water extract (no. 309) of desiccated, pulverized, human tubercle bacilli, of which 0.1 cc. was injected into each animal. A given amount of water extract had been first diluted with an equal quantity of physiological salt solution, so that each animal received a total bulk of 0.2 cc. of fluid.

All animals of lot 1 were to be reinfected in the tuberculin-reacting areas, approximately one-half of them on the same side as the primary lesion and one-half on the side opposite, on November 5, or *four full days after the injection of tuberculin.*

Lot 2: On November 3, nos. 11 to 20 were similarly injected intracutaneously with 0.1 cc. W. E. 309 on the left side (opposite to lesion), and nos. 41 to 50 with 0.1 cc. W. E. 309 on the right (same) side.

All animals of lot 2 were to be reinfected, in the same way as those of lot 1, on November 5, or *two full days after the injection of the tuberculin.*

Lot 3: On November 4, nos. 21 to 29 were injected intracutaneously with 0.1 cc. W. E. 309 on the left side (opposite to lesion), and nos. 51 to 60 with 0.1 cc. W. E. 309 on the right (same) side.

All animals of lot 3 were to be reinfected, in the same way as those of lots 1 and 2, on November 5, or *one day after the injection of tuberculin.*

The results of the skin injections. Between tuberculin injection and reinfection observations were made on all animals every day and the results recorded. Without exception the skin of every animal reacted vigorously, with redness, oedema and induration that in most cases reached a maximum of 20 by 20 mm. or more. Reactions usually reached their height between twenty-four and forty-eight hours after injection: few seemed complete at the end of twenty-four hours, while none increased after forty-eight hours. For the individuals of the several series the results were as uniform as is ever observed under similar conditions.

But there was an apparently significant difference in result, if one followed and compared the reactions set up in the side opposite to the lesion with those induced on the same side.

It was noticed that the skin reaction on the same side *began* as vigorously as that on the opposite side but that it did not reach as high a maximum and it subsided more rapidly. On the same side there occurred hardly necrosis or haemorrhage: while on the opposite side these were often marked.

At the same time there was usually a marked focal reaction on the same side. The superficial inguinal nodes swelled enormously and frequently the entire skin from the site of tuberculin injection to that overlying the nodes and apparently the subcutaneous tissue took part in the reaction and became red and oedematous. There was often a confluent band-like area of oedema reaching from the point of injection to the nodes. The subcutaneous tissue was apparently the most involved, and gave to the entire area of reaction an appearance as though the skin itself was much more inflamed than in those in which injection had been performed on the opposite side. This was especially noticeable after twenty-four hours, following which the skin reaction underwent a rapid subsidence.

What had happened, of course, was that tuberculin, applied to the same side as the lesion, had drained lymphatically to the infected right superficial inguinal nodes and here set up a focal reaction. The intracutaneous reaction had begun earlier than the focal reaction and in the regular way. But soon the focal reaction ensued and brought about not only changes in its neighborhood but also a constitutional reaction.

We are fairly certain that a constitutional reaction is set up by a focal reaction (10). We also know that the effect of a constitutional reaction

is to blunt the skin reaction (2). As soon, therefore, as a constitutional effect was produced by the focal reaction, the former began to diminish the skin reaction which was in progress at the time. All this was plain in these animals and served to emphasize how complicated are the various interdependent relations between these three types of reaction in the tuberculous animal, that is, the intracutaneous (tissue) reaction, the focal reaction, and the constitutional reaction.

The injections of tuberculin on the side opposite to the lesion did not arouse any visible focal effects. This tuberculin would, of course, drain to regionary, noninfected nodes and then past these and ultimately reach the blood. Whatever tuberculin would reach the infected right superficial inguinals would be only that minimal amount which was conveyed to these by their arterial blood, and this was insufficient to induce reaction in them. The skin reactions accordingly followed the rule that is always observed in ordinary tuberculous animals.

As has been said above, all reactions were subsiding by the end of forty-eight hours. By the end of four days almost all of the very acute features of the inflammations were gone. When, therefore, on November 5, we came to reinfect these animals into the tuberculin-reacting areas, we made our inoculations into several varying stages of inflammation, as follows:

In lot 1 the acute inflammations had largely subsided.

In lot 2 they were subsiding.

In lot 3 they had not yet reached their height but were still developing.

In other words reinfection with living bacilli were performed (1) into stationary or fading reactions,—lots 1 and 2; and (2) into progressing reactions.

3. Reinfection of reacting animals and nonreacted tuberculous controls, and primary infection of normal controls. For this purpose the following emulsion was used:

The contents of two glycerine-agar tubes of sixteen day old, vigorously growing, virulent, human tubercle bacilli (strain H37, Saranac Laboratory) were rubbed up in a mortar with a drop or two of physiological salt solution. To this paste was carefully added, drop by drop, and with the emulsion being continually stirred, 15 cc. of physiological salt solution. The resulting thick suspension was then centrifugated for ten minutes at high speed (about 3000 revolutions per minute). The supernatant suspension was milky in appearance. It was withdrawn and filtered through cotton, and about 7 cc. of fresh physiological salt solution were

added to the 5 cc. of the filtrate and thoroughly mixed with the latter. The fluid appeared perfectly limpid but stained smears showed it to contain too many bacilli in clumps. It was accordingly again filtered through cotton; and to the 4 or 5 cc. that filtered through, from 5 to 7 cc. of fresh salt solution were added and thoroughly mixed. Stained smears of this latter fluid showed an even distribution of bacilli, nearly all of which were single and averaged about 3 to 5 to the oil immersion field. There were, however, still a very few small clumps, made up of two or three bacilli. It was therefore again diluted with 5 cc. of salt solution. This final suspension exhibited about 2 or 3 bacilli to the oil immersion field and was at once used for inoculation.

On November 5 each animal of lots 1, 2 and 3 was inoculated as previously described with 0.1 cc. of the above suspension; and at the same time the same dose of the same suspension was inoculated intracutaneously into 2 other lots of guinea pigs. These latter were:

Lot 4: Comprising the remaining 9 animals, numbered 61 to 69, of the 70 which received a primary infection on September 26. These had not been injected with tuberculin. They were to be the tuberculous controls of the experiment, to indicate to us how much basic immunity had been conferred upon the guinea pigs by the primary R 1 infection. They were inoculated on the left (opposite to R 1 lesion) side.

Lot 5: Comprising 10 normal nontuberculous guinea pigs, numbered 88 to 97. These were to serve as controls which would point out the infectiousness of 0.1 cc. of our H 37 suspension in nonimmune animals.

To recapitulate: Under exactly similar conditions of time and dosage 18 guinea pigs were intracutaneously infected into the subsided inflammatory areas of tuberculin skin reactions, 8 on the side opposite to a primary R 1 infection and 10 on the same side; 20 were infected into subsiding or stationary inflammatory areas, 10 on the same side as primary lesion and 10 on the opposite side: 19 were infected into developing areas of inflammation, 9 on the side opposite to primary lesion and 10 on the same side; 9 were infected into previously untouched skin, which was however allergic because the animals had previously been rendered tuberculous, and the reinfections were performed on the side opposite to the primary lesions; and 10 were infected into skins that were normal because the animals were nontuberculous and therefore nonallergic and nonimmune.

The following faults of technique were committed during the H 37 infections: nos. 8 and 58 received 0.15 cc. of the suspension, instead of

the uniform 0.1 cc.; in nos. 12, 13 and 36 the inoculations were more subcutaneous than intracutaneous; and in nos. 41, 46, 47 and 69 the inoculations were incomplete, that is, slightly less than the usual dose of 0.1 cc. It is questionable whether these errors influenced the results to any extent, though in nos. 12, 13 and 36 the local lesions were less severe than in the general run of animals of their series.

THE IMMEDIATE RESULTS OF THE VIRULENT INOCULATIONS

In lots 1 and 2. We have said that in these animals reinfection was performed into subsiding or stationary inflammations. At twenty-four hours after the inoculation there was no increase in the inflammations over the condition noted the day before, just before inoculation.

In lot 3. Twenty-four hours after inoculation most of these animals showed more of a skin reaction than on the day of reinoculation. These were the animals which were infected into the reacting areas, twenty-four hours after the injection of tuberculin. Since it takes over twenty-four hours, as a rule, for an intracutaneous reaction to reach its maximum, it was likely that the reaction which was in progress when reinfection was performed had simply gone ahead to its full development.

At any rate it was impossible to detect anything that suggested that the introduction of the living bacilli into the reacting areas of lots 1, 2 and 3 had "whipped up" the reactions.

In lot 4. These animals all showed the allergic phenomenon at its prettiest. It will be remembered that they were not given tuberculin. With this exception they were simply tuberculous animals that had been tuberculized in exactly the same way as the individuals of lots 1, 2 and 3; and into their normal appearing, though hypersensitive, skins the same doses of virulent tubercle bacilli had been inoculated. At the end of twenty-four hours all showed at the sites of inoculation delicate, though definite skin reactions, due to the introduction, not of tuberculin, but of living tubercle bacilli.

The reactions were plain areas of redness which averaged 20 by 20 mm. in diameter. There was moderate oedema (+ + on the average) and induration in all. In a few there were slight evidences of central necrosis. They were not to be compared to those produced by 0.1 cc. of water extract. But it was remarkable that so few bacilli—there could not have been more than several hundred in the doses which we employed —could release enough protein to arouse the reaction. The result was a

brilliant example of how sensitive the allergic state is to even minute amounts of antigen; and illustrated anew that *allergic tissues (those of tuberculous animals) react with inflammation to living bacilli exactly like they do to tuberculin.*

The results in lot 4 showed the bacilli meeting with inflammatory conditions that were again different than obtained in the animals of lots 1, 2, and 3. In the latter series varying grades of inflammation were present when the bacilli were inoculated; in the former there was no inflammation at the time of inoculation: the bacilli were introduced into noninflamed soil and did not come under the influence of inflammation until several hours later when exudation began to develop because of their presence in allergic tissues.

In lot 5. At twenty-four hours there was not the slightest trace of reaction in these, the normal controls. All skins were smooth and flat, and only a faint point of redness due to trauma indicated where the inoculation had been made the day before.

During the first week after inoculation observations were made almost daily. At three days, the reacting areas in practically all the animals had cleared up. In the case of the nontuberculous controls (lot 5) there was not the slightest sign of the inoculation. In the tuberculous controls (lot 4) but faint traces remained, except a small, slightly indurated spot; while by five days in these animals the acute inflammation had totally subsided, but in their place there now appeared small, indurated and faintly red nodules, about 3 by 3 mm. in size. At five days the skins of the normal controls (lot 5) were perfectly normal.

By the end of the first week marked differences between the several series of animals began to appear. The most striking contrast was between the members of lot 4, the nontuberculinized, tuberculous controls and those of lot 5, the normal controls.

Every animal of lot 4 now had a definite nodule, at the site of inoculation, which projected above the surface and averaged about 6 by 6 mm. in size. In other words, there was occurring here an accelerated development of real tubercle, in the area where there had previously been a rapid, acute inflammation. The regionary lymph nodes showed no changes.

On the other hand, with the exception of one animal, none of the nontuberculous controls (lot 5) showed any reaction. The skin was flat and smooth, and to all appearances normal. The contrast was really remarkable; and the result emphasized once more that a hypersensitive

(tuberculous) animal reacts to tubercle bacilli, not only with an immediate acute inflammation, but also with an accelerated development of tubercle soon after the acute inflammation has subsided. There is considerable evidence that during the allergic reaction to living bacilli, some of the latter are destroyed very soon after implantation (11). In allergic animals therefore the *tubercular* reaction must take place to fewer bacilli than in primarily infected animals: yet tubercle formation occurs earlier than in the latter. This fact suggests that in tuberculo-hypersensitiveness there exists, not only a changed reaction that is manifested by exudative phenomena, but also an altered reacting capacity of cells of the fixed tissue type. We will not pause here to discuss further the probability and meaning of this latter component of allergy. They are referred to at greater length in another communication (12).

At the time we are considering, the manifestations at the sites of inoculation in the guinea pigs of lots 1, 2 and 3 were variable. Many, like those of lot 4, showed nodular tubercle developing: many others had scabs covering the site, or the scabs had dropped off, leaving ulcers.

Fifteen days after inoculation (November 20), the ulcerated points of the reinfected animals had nearly all closed over, and in many the areas of tuberculin reaction were irregular and nodular. Many of the areas again ulcerated later.

It will be remembered that at seven days there were no nodules in the skin of the normal controls (lots 5). During the past week, however, nodules had appeared. They were now developing rapidly and at this time (fifteen days) usually equalled those of lot 4 (tuberculous controls) in size. They were softening and apparently getting ready to break down, while in lot 4 evidences of suppuration were slight or absent. But the main change was a definite, and in a few instances marked, involvement of the regionary lymph nodes of the members of lot 5. Only a very few of all the reinfected animals showed palpable lymph node changes at this time: in most, the nodes were entirely normal.

From now on the local lesions which were accessible to observation followed varying courses of development in the several series. Weekly records were made of all animals and on January 7, 1920, or nine weeks after virulent infection, the experiment was terminated and all animals killed and autopsied on the same day.

THE FINAL RESULTS OF THE VIRULENT INOCULATIONS

Between virulent infection and the end of the experiment only three animals, no. 11 (lot 2) and nos. 23 and 60 (lot 3), died. None of the deaths were due to tuberculosis. There remained, therefore, 73 guinea pigs.

The main interest, of course, lies in the variations of immunity brought about by the tuberculin inflammations. To judge this we had two bases of comparison: (1) the results of the virulent inoculations in the normal, nontuberculous animals of lot 5 which would indicate the normal infectiousness of the suspension employed; and (2) the results in the nontuberculinized animals of lot 4, which would point out the essential immunity conferred by the primary R1 infections. If any series showed, on the average, less tuberculosis than lot 4, we would be justified in concluding that its immunity had been increased by our procedures: if it exhibited greater involvement than lot 4 but less than lot 5, it was manifest that we had reduced an immunity which it once possessed.

We present the varying results in the several lots of animals in the accompanying series of tables (table 1 to 8), in which are brought together all the significant data that have a bearing on resistance to the virulent infection. Thoroughly complete and detailed analysis of these records is impossible and the presentation of too much detail would likely result only in confusing the broader issues which the experiment disclosed. We will content ourselves, therefore, with what will be for the most part merely summarized interpretations of the tables.

The tables bring together the following information: the character of the site of inoculation at the time of infection; data concerning the local skin lesion such as the presence or absence of ulceration, the time of the latter's first appearance and its general character and degree, the general character and degree of the local lesion throughout the experiment and its character at the end of the experiment; changes in the regionary lymph nodes, such as the time of first palpable changes and the maximum degree of involvement of both inguinal and axillary nodes; and, finally, the location and degree of tuberculous involvement in spleen, liver and lungs.

Comparison of tables 7 and 8 discloses at a glance that the basic immunity to virulent infection, conferred by the primary R1 inoculation, was high and very competent. All of the originally normal animals (table 8) became pretty thoroughly tuberculous by the end of nine weeks.

Local ulceration in them was uniformly quite early, and was, in the main, progressive. The nearest draining lymph nodes, the inguinals, were all involved by the end of fifteen days and their involvement became extreme. The spleens of all showed advanced tuberculosis, while the majority had slight to moderate involvement of the liver and slight lesion in the lungs.

On the other hand the tuberculous animals, which had been inoculated without preliminary tuberculinization of the skin, with two exceptions exhibited no visceral lesion whatever and in one of the exceptions, no. 61, the lesion of the spleen was doubtful (table 7). The one animal, no. 67, which had definite visceral lesion, had this confined to a single small tubercle of the spleen. In all these animals the local lesion was nonprogressive, while the majority suffered no palpable involvement of their regionary inguinal nodes. *Of all the reinfected animals, these showed in every way the highest immunity to virulent inoculation.*

The animals whose resistance ranked next to that of the nontuberculinized, tuberculous controls were those which had been inoculated into reacting areas four days after tuberculin was injected (lot 1); and of these the results were a little better in the animals which were infected on the side opposite to the lesion.

In the animals of lots 2 and 3, those infected two days and one day respectively after tuberculin injection, there was in general a good deal more tuberculosis than in those of lot 1. There is not very much difference in results between the members of lot 2 and lot 3, except perhaps that lot 3 have slightly more involvement. But it is plain in each series that when reinoculation was performed into reacting areas on the same side as the primary lesion, it is met with diminished resistance as compared with infection into the opposite side.

In order to limit the scope of this paper to a plain statement of the experiment and its results, we shall not at this place enter upon a discussion of the causes and significance of these results. This is reserved for a more general consideration of allergy and immunity to tuberculosis which will appear in another paper. We would here merely draw from our experiment the following deductions:

If, because of an existing tuberculous infection, an animal (guinea pig) has acquired a given degree of allergy and immunity, both of these are reduced under the following conditions:

1. They are reduced at the site of an inflammatory tuberculin reaction for at least four days after the application of the tuberculin.

2. They are more reduced by inflammatory tuberculin reactions at places which are within the lymphatic drainage area of tuberculous foci than at places which are not so situated.

3. They are reduced to a greater extent shortly (one to two days) after the application of tuberculin than later (four days after tuberculin).

The part played by the inflammation of the allergic reaction, considered purely by itself, remains undisclosed.

REFERENCES

(1) Krause, A. K.: Cellular or tissue immunity to tuberculosis and its relation to the pathology of tuberculosis. Tr. Nat. Assoc. Study & Prev. Tuberc., 1916, 253.

(2) Krause, A. K.: Experimental studies on the cutaneous reaction to tuberculo-protein. First paper: Factors governing the reaction. J. Med. Res., 1916, xxxv, 1.

(3) Krause, A. K.: The nature of resistance to tuberculosis. Amer. Rev. Tuberc., 1917, i, 65, and Bull. Johns Hopkins Hosp., 1917, xxviii, 191.

(4) Krause, A. K.: Tobacco smoke and pulmonary tuberculosis. Bull. Johns Hopkins Hosp., 1918, xxix, 106.

(5) Krause, A. K., and Willis, H. S.: Further experiments on the influence of protein intoxication on the tuberculous infection of guinea pigs. Amer. Rev. Tuberc., 1919, iii, 153.

(6) Krause, A. K.: Studies on tuberculous infection. I. A note on experimental tracheobronchial node tuberculosis together with a brief consideration of several phases of tuberculous infection suggested thereby. Ibid., 1919, iii, 1.

(7) Trudeau, E. L.: Artificial immunity in experimental tuberculosis. N. Y. Med. J., July 18, 1903.

(8) Trudeau, E. L.: Two experiments in artificial immunity against tuberculosis. Med. News, September 30, 1905.

(9) Krause, A. K.: The anaphylactic state in its relation to resistance to tuberculous infection and tuberculous disease (An experimental study). J. Med. Res., 1916, xxxv, 25.

(10) Krause, A. K.: Concerning the general tuberculin reaction. Ibid., 1916, xxxv, 43.

(11) Rist, E., and Rolland, J.: Étude sur la réinfection tuberculeuse. Troisième mémoire. La rèinfection cutanée et le phénomène de Koch. Annal. de Méd., 1914, ii, 13.

(12) Krause, A. K., and Peters, Dorothy: Studies on immunity to tuberculosis. A description of graphic records of the local allergic and immune reactions to tuberculous reinfection in guinea pigs. Amer. Rev. Tuberc., 1920, iv, 551.

TABLE 1

Lot 1. Results of virulent reinoculations into tuberculin-inflamed areas, four days after the intracutaneous injection of tuberculin on the side opposite to the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION: Ulceration: Presence	LOCAL LESION: Ulceration: Time of ulceration in number of days after inoculation	LOCAL LESION: Ulceration: General character and degree of ulceration	LOCAL LESION: General character and degree of local lesion throughout the experiment	LOCAL LESION: Character of local lesion at time of death (autopsy)	REGIONARY LYMPH NODES: Inguinals: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Inguinals: Maximum degree of involvement	REGIONARY LYMPH NODES: Axillaries: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Axillaries: Maximum degree of involvement	LOCATION AND DEGREE OF VISCERAL INVOLVEMENT (SP. = SPLEEN, LV. = LIVER, LG. = LUNGS)
1	Redness slight Scab in center	+	5	Small, 3 x 6 mm.	Sluggish nodular lesion	Multinodular area	21	++	49	+	Sp.: ++ Lv.: slight
3	Redness: 25 x 25 Necrotic-hemorrhagic center Induration: ++++	+	7	Very large, 20 x 10	Rapidly healing	Healed, skin smooth	21	++	49	+	0
4	Redness: 25 x 15 Necrotic center Induration: +++	+	10	Small, 6 x 8	Very rapid healing	Healed	15	++	56	+	0
5	Redness: 15 x 15 Hemorrhagic center Induration: +++	+	7	Small	Slight and nonprogressive	Slight multinodular area	21	++	35	+	0
6	Redness: 22 x 20 Necrotic-hemorrhagic center Induration: +++	+	7	Small, 6 x 10	Very slowly progressive	Slight multinodular area	21	++	42	+	Sp.: +

7	Redness: 0 Induration: + Had been marked reaction at 48 hrs.	+	10	Very small	Stationary nodule	Slight multinodular area	15	++	0	0	0
8	Redness: 0 Induration: + Had been moderate reaction at 48 hrs.	+	5	Very small, 2 x 5	Very slowly progressive	Slight multinodular area	21	++	56	+	Sp.: ++
10	Redness: 0 Induration: + Had been marked reaction at 24 hrs.	+	5	Very small	Very slowly progressive	Slight multinodular area	21	+++	56	+	0

TABLE 2

Lot 1. Results of virulent reinoculation into tuberculin-inflamed areas, four days after the intracutaneous injection of tuberculin on the same side as the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION: ULCERATION: Presence	LOCAL LESION: ULCERATION: Time of ulceration in number of days after inoculation	LOCAL LESION: ULCERATION: General character and degree of ulceration	LOCAL LESION: General character and degree of local lesion throughout the experiment	LOCAL LESION: Character of local lesion at time of death (autopsy)	REGIONARY LYMPH NODES: Inguinals: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Inguinals: Maximum degree of involvement	REGIONARY LYMPH NODES: Axillaries: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Axillaries: Maximum degree of involvement	LOCATION AND DEGREE OF VISCERAL INVOLVEMENT (SP. = SPLEEN, LV. = LIVER, LG. = LUNGS)
31	Redness: 6 x 6 Small scab in center Induration: +	0			Very slowly progressive nodular	Slight multinodular area			42	+	0
32	Redness: 10 x 10 and very faint. Hemorrhage in center. Induration: ++	+	7	Very small	Slight, very rapidly healed	Healed			42	+	Sp.: +
33	Redness: 0 Scratch marks and scab Induration: +	+	10	Small and rapidly healed	Non-progressive and healing	Almost healed			42	+	0
34	Redness: 10 x 10 Scab Induration: +	0			Small nodule rapidly disappearing	Healed			63	+	0
35	Redness: 0 Scratches and scab Induration: +++	+	10	Small	Very sluggish nodular	Multinodular area			63	+	Sp.: ++ Lv.: slight

36	Redness: 0 Scab Induration: +	0			Increasing nodular	Large multinodular area			42	++	Sp.: +++ Lv.: +++ Lg.: +
37	Redness: 10 x 10 Scab Induration: +	+	10	Very minute	Slight with rapid healing	Healed			42	+	0
38	Redness: 15 x 15 Induration: ++	+	10	Small	Sluggish nodular	Multinodular scabbed			0		0
39	Redness: 0 Marked scratches Induration: ++	+	3	Small	Slow, nodular going on to abscess	Multinodular, ulcerated			0		Sp.: + Lv.: + Lg.: +
40	Redness: 20 x 20 Central necrosis Induration: ++	+	1	Large	Very rapid healing after early ulceration	Healed			0		0

TABLE 3

Lot. 2. Results of virulent reinoculation into tuberculin-inflamed areas, two days after the intracutaneous injection of tuberculin on the side opposite to the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION: Ulceration: Presence	LOCAL LESION: Ulceration: Time of ulceration in number of days after inoculation	LOCAL LESION: Ulceration: General character and degree of ulceration	LOCAL LESION: General character and degree of local lesion throughout the experiment	LOCAL LESION: Character of local lesion at time of death (autopsy)	REGIONARY LYMPH NODES: Inguinals: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Inguinals: Maximum degree of involvement	REGIONARY LYMPH NODES: Axillaries: Time of first palpable changes: Days after inoculation	REGIONARY LYMPH NODES: Axillaries: Maximum degree of involvement	LOCATION AND DEGREE OF VISCERAL INVOLVEMENT (SP. = SPLEEN, LV. = LIVER, LG. = LUNGS)
12	Redness: 32 x 25 Necrotic center: scab Induration: +++	+	7	Early rapidly healing	Very sluggish nodular	Multinodular almost healed	15	++	0		Sp.: ++ Lv.: +
13	Redness: 20 x 18 Pale center Induration: +++	+	21	Late minute transient	Slight nodule	Healed	35	+	0		0
14	Redness: 0 Induration: +	+	21	Late, small, persistent	Slowly progressive nodule	Large multinodular, ulcerated	29	+	42	+	Sp.: ++ Lv.: +
15	Redness: 30 x 30 Scratch marks Induration: ++	+	15	Abscess rapid healing	Persistent nodular	Small multinodular	49	+	49	+	Sp.: +
16	Redness: 32 x 35 Necrotic center Induration: +++	+	7	Early rapidly healing	Persistent nodular	Small multinodular	42	+	56	+	Sp.: +

17	Redness: 20 x 20 Necrotic center Induration: ++	+	10	Very early healing	Slight nodule	Healed	42	+	0		0
18	Redness: 15 x 15 Necrotic center Induration: ++	0			Slight nodule	Slight multinodular	42	+	0		Sp.: ++ Lv.: +
19	Redness: very faint: 25 x 30 Necrotic Induration: +++	+	7	Transient	Very small nodule	Almost healed	21	++	0		0
20	Reaction gone At 24 hours had been 25 x 20 with ++ induration	0			Very slight nodule	Healed	42	+	63	+	0

TABLE 4

Lot 2. Results of virulent reinoculation into tuberculin-inflamed areas, two days after the intracutaneous injection of tuberculin on the same side as the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION					REGIONARY LYMPH NODES				LOCATION AND DEGREE OF VISCERAL INVOLVEMENT
		Ulceration					Inguinals		Axillaries		
		Presence	Time of ulceration in number of days after inoculation	General character and degree of ulceration	General character and degree of local lesion throughout the experiment.	Character of local lesion at time of death (autopsy)	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Sp. = spleen Lv. = liver Lg. = lungs
41	Redness: 15 x 10 and very faint Induration: +	0			Slight and hardly nodular	Healed			0		Sp.: + Lv.: 0 Lg.: +
42	Redness: 5 x 5, very faint Induration: +	+	35	Slight	Sluggish recurrent ulcer	Scabbed ulcer			35	+	Sp.: ++
43	Redness: 15 x 15 Induration: +++	+	7	Early and small	Rapid healing	Healed			49	+	Sp.: +
44	Redness: 15 x 20 Induration: +	+	21	Small with abscess	Early tubercle going on to abscess and ulceration	Nodular scabbed			49	+	0
45	Redness: 15 x 15 Induration: +	+	15	Small and rapidly healing	Sluggish tubercular	Multinodular scabbed			49	++	Sp.: +

46	Redness: 15 x 20 Induration: ++	+	7	Small sluggish and recurrent	Slight and almost stationary	Slight skin flat scabbed			63	+	Sp.: + Lv.: 0 Lg.: slightly +
47	Redness: 20 x 20 Induration: ++	+	5	Early with very rapid healing	Early ulceration without much tubercle	Healed			42	+	Sp.: +
48	Redness: 22 x 20 Induration: ++	+	7	Small and recurrent	Slight and stationary tubercle	Slightly scabbed			56	+	Sp.: ++
49	Redness: 20 x 20 Induration: ++	+	10	Early healing	Slowly progressive tubercle	Large and multinodular			42	+	Sp.: +++ Lv.: +++ Lg.: +
50	Redness: 15 x 12 Induration: ++	+	21	Slight	Very sluggish nodule	Almost healed scabbed			42	+	0

TABLE 5

Lot 3. Results of virulent inoculation into tuberculin-inflamed areas, one day after the intracutaneous injection of tuberculin on the side opposite to the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION					REGIONARY LYMPH NODES				LOCATION AND DEGREE OF VISCERAL INVOLVEMENT
		Ulceration					Inguinals		Axillaries		Sp. = spleen Lv. = liver Lg. = lungs
		Presence	Time of ulceration in number of days after inoculation	General character and degree of ulceration	General character and degree of local lesion throughout the experiment	Character of local lesion at time of death (autopsy)	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	
21	Redness, very faint: 25 x 25 Induration: ++	+	15	Slight and non-progressive	Slight and stationary	Multinodular scabbed	21	+++	21	++	Sp.: +
22	Redness, very pale: 23 x 23 Induration: ++	0			Very small nodule	Skin flat, almost healed	21	++	35	++	0
24	Redness: 20 x 20 Scratch marks Induration: ++	+	21	Slight and non-progressive	Small nodule	Multinodular scabbed	29	++		0	Sp.: + Lv.: 0 Lg.: slightly +
25	Redness: 30 x 30 Pale center Induration: +++	+	7	Slight non-progressive	Small nodule	Multinodular slight scab	15	++	56	+	Sp.: +++ Lv.: +
26	Redness: 30 x 30 Pale center Induration: +++	+	7	Slight and slowly healing	Small indolent nodule	Multinodular slight scab	29	++	63	+	0

27	Redness: 25 x 20 Pale center Induration: ++	+	21	Slight	Indolent nodule	Multinodular scab	29	++	49	+	0
28	Redness: 30 x 23 Small haemorrhage Induration: ++	+	7	Small	Slowly healing nodule	Healed	10	++	49	+	0
29	Redness: 30 x 27 Haemorrhagic spot Induration: +++	+	7	Small	Small healing nodule	Healed	10	++	49	+	0

TABLE 6

Lot 3. Results of virulent reinoculation into tuberculin-inflamed areas one day after tuberculin injection on the same side as the primary infection

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION					REGIONARY LYMPH NODES				LOCATION AND DEGREE OF VISCERAL INVOLVEMENT
		Ulceration.					Inguinals		Axillaries		
		Presence	Time of ulceration in number of days after inoculation	General character and degree of ulceration	General character and degree of local lesion throughout the experiment	Character of local lesion at time of death (autopsy)	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Sp. = spleen Lv. = liver Lg. = lungs
51	Redness: 25 x 20 Induration: +	+	7	Small, slowly healing	Slowly healing nodule	Healed			56	+	Sp.: +
52	Redness: 25 x 25 Induration: +++	+	35	Late progressive ulcer	Nodule ulcerating late	Large open ulcer			29	+++	Sp.: +++ Lv.: ++ Lg.: +
53	Redness: 25 x 30 Induration: +++	+	7	Small, sluggish	Nodule becoming abscess	Multinodular scabbed			42	+++	Sp.: +
54	No redness or induration	+	7	Small nonprogressive	Small nodule	Slight, almost healed			29	+	0
55	Redness: 18 x 20 Induration: ++	+	7	Small and indolent	Slowly developing nodules	Multinodular scabbed			35	+++	Sp.: ++++ Lv.: +++ Lg.: ++
56	Redness: 0 Induration: ++	+	7	Slowly healing	Slowly developing nodules	Multinodular no ulcer			42	+	Sp.: ++++ Lv.: + Lg.: +

57	Redness: 0 Induration: +	+	7	Slight	Slowly developing nodules	Multinodular			56	+	Sp.: +++ Lv.: +
58	Redness: 20 x 20 Haemorrhagic spot Induration: ++	+	7	Slight	Small nodules	Multinodular scabbed			49	+	Sp.: +
59	Redness: 22 x 22 Induration: +++	+	5	Slowly healing	Very nodular	Multinodular scabbed			56	++	0

TABLE 7

Lot 4. Results of virulent reinoculation into the non-tuberculinized non-inflamed skins of tuberculous animals. These animals are the tuberculous controls

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION					REGIONARY LYMPH NODES				LOCATION AND DEGREE OF VISCERAL INVOLVEMENT
		Ulceration					Inguinals		Axillaries		
		Presence	Time of ulceration in number of days after inoculation	General character and degree of ulceration	General character and degree of local lesion throughout the experiment	Character of local lesion at time of death (autopsy)	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Sp. = spleen Lv. = liver Lg. = lungs
61	Normal skin (animal allergic)	+	21	Slight and rapidly healing	Non-progressive	Small closed nodular area	29	++	0		Sp.: ?
62	Normal skin (animal allergic)	+	42	Small and rapidly healing	Non-progressive	Small closed nodular area	0		0		0
63	Normal skin (animal allergic)	+	21	Minute and rapidly healing	Non-progressive	Small, flattened nodule	0		0		0
64	Normal skin (animal allergic)	+	29	Small and rapidly healing	Non-progressive	Small nodular closed area	21	+	0		0
65	Normal skin (animal allergic)	0			Non-progressive	Very small closed nodule	21	+	0		0

66	Normal skin (animal allergic)	0			Non-progressive	Minute nodule with slight scab	0		0		0
67	Normal skin (animal allergic)	+	21	Small and sluggishly healing	Very slowly progressive	Small closed nodular area	0		35	+	Sp.: + (1 small nodule)
68	Normal skin (animal allergic)	+	15	Small and rapidly healing	Non-progressive	Minute nodule; almost disappeared	29	++	35	+	0
69	Normal skin (animal allergic)	+	21	Small and slowly healing	Non-progressive	Minute nodule; almost disappeared	0		35	+	0

TABLE 8

Lot 5. Results of virulent primary inoculation into the normal skins of nontuberculous animals. These animals are the normal controls

ANIMAL	CHARACTER OF SITE OF INOCULATION AT TIME OF INOCULATION	LOCAL LESION					REGIONARY LYMPH NODES				LOCATION AND DEGREE OF VISCERAL INVOLVEMENT
		Ulceration					Inguinals		Axillaries		
		Presence	Time of ulceration in number of days after inoculation	General character and degree of ulceration	General character and degree of local lesion throughout the experiment	Character of local lesion at time of death (autopsy)	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Time of first palpable changes: Days after inoculation	Maximum degree of involvement	Sp. = spleen Lv. = liver Lg. = lungs
88	Normal skin	+	15	Subsiding	Not marked	Healed	15	++++	56	+	Sp.: ++++ Lv.: ++ Lg.: +
89	Normal skin	+	21	Persistent	Indolent development of nodules	Ulcer nodular scabbed	15	++++	35	++	Sp.: +++ Lv.: 0 Lg.: +
90	Normal skin	+	21	Persistent	Widespread development of nodules	Large ulcer, widely disseminated nodules	15	++++	21	++++	Sp.: ++++ Lv.: ++ Lg.: slightly +
91	Normal skin	+	21	Increasing	Slow and local development of nodules	Large ulcer nodular	15	++++	35	+	Sp.: ++++ Lv.: ++++ Lg.: slightly +
92	Normal skin	+	21	Gradual increase	Slow development of nodules	Large ulcer nodular	15	++++	42	+	Sp.: +++ Lv.: no record Lg.: very slightly +

93	Normal skin	+	15	Gradual increase	Slow development of nodules	Large ulcer nodular	15	++++	21	+	Sp.: +++ Lv.: +++ Lg.: +
94	Normal skin	+	21	Gradual increase	Slow development of nodules	Deep ulcer nodular	15	++++	21	++	Sp.: +++ Lv.: ++ Lg.: 0
95	Normal skin	+	15	Gradual increase	Slow development of nodules	Deep ulcer nodular	15	++++	21	++	Sp.: ++++ Lv.: + Lg.: +
96	Normal skin	+	15	Gradual increase	Slow development of nodules	Deep ulcer nodular	15	++++	21	++	Sp.: +++ Lv.: 0 Lg.: +
97	Normal skin	+	15	Gradual increase	Slow development of nodules	Deep ulcer nodular	15	++++	29	++	Sp.: ++++ Lv.: 0 Lg.: 0

THE EFFECT OF ARTIFICIAL PNEUMOTHORAX ON PULMONARY TUBERCULOSIS IN THE RABBIT

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The treatment of pulmonary tuberculosis by means of artificial pneumothorax has a well established place in clinical therapeusis. Nevertheless, until very recently, the study of the effects of artificial pneumothorax upon experimental tuberculosis seems to have escaped attention. Historically (1), the conception of artificial pneumothorax as a therapeutic procedure dates back about one hundred years, when (1821) James Carson reported physiological experiments, in which he measured the pressure which balances the elasticity of the lung, and suggested compression as a secure, simple and complete remedy for suppurative lesions or cavities of this organ, although he never practically applied it. Ramadge some years later, however, tried this procedure on a patient with ulcerative phthisis with apparent success; but at the time his views attracted no notice. With the advent of antiseptic surgery Cayley in 1885 tried to cure a severe pulmonary hemoptysis by producing lung collapse, with success. His report was well received and had his technique been better the collapse method would probably have progressed more rapidly at that time. Adams in 1887 in England, Späth in 1888 in Germany and Hérard in 1881 wrote to the effect that curative influences occurred in tuberculous cavities of the lung as a result of spontaneous hydropneumothorax. Potain in 1885 to 1888 deliberately injected sterilized air into the pleural cavity, in three cases of spontaneous pneumothorax with liquid effusion, to maintain immobilization. He also accurately measured the intrapleural pressure, and constantly referred to the possibility of curing phthisis by artificial pneumothorax; but he found no followers. Forlanini's first papers in 1882 dealt with the dependence of ulcerative processes in the lung upon mechanical causes, and showed that pleural effusion or spontaneous pneumothorax often result in an arrest of the phthisical process. In 1888 he for the first time injected air into a pleural effusion, but not until 1894 did he publish his first two cases of artificial pneumothorax. He, however, had

no followers and made no further reports until 1906. In 1898 J. B. Murphy contributed to the subject and presented his arguments in favor of compressing the lungs for tuberculosis and the methods by which such pulmonary quiescence or collapse can be obtained. He believed the intrapleural injection of gas or fluid to be preferable. He tried this on 5 cases, 2 failing on account of pleural adhesions, and the other 3 giving excellent results. The following year Lemke, a pupil of Murphy's, reported on 53 cases treated with intrapleural injections of nitrogen. Murphy, fully convinced of the scientific value of pneumothorax, persistently refused to use it, because it would take him out of surgery into medicine. However, Murphy's and Lemke's labors attracted the attention of Brauer at Marburg, and it was through Brauer's influence that compression therapy became a rational and methodical procedure. Brauer and his pupils have also contributed largely to the scientific understanding of the effects of pneumothorax.

From a study of the literature there seems to be a general uniformity of opinion regarding the resultant effect of the pneumothorax upon the diseased lung and it is usually conceded to be of an inhibitory nature, although the details of the mechanism of this action are somewhat open to discussion. Anatomical studies of the effects of pnemothorax upon tuberculous lungs are few and usually their interpretation is open to question. In most cases there is a tendency to the production of fibrous tissue in the compressed lungs with a collapse and healing of cavities. Grätz (2) as a result of the histological study of 3 cases, in which compression had been produced, concludes that rest of the tuberculous lung causes a quiescence of the tuberculous process with subsequent healing, which appears as an encapsulation of the caseous areas and an organization of the pneumonic areas. The stimulation to connective growth has its explanation in the stasis in the lymph circulation and the resultant diminished absorption of the tuberculous toxins.

Warnecke (3) studied a case histologically with care and found that the collapsed lung tended toward a diffuse, chronic induration or cirrhosis, while the other lung was affected with a progressive type of the disease. He concluded that artificial pneumothorax produces a favorable influence upon pulmonary tuberculosis from a pathological anatomical viewpoint. Kistler (4), like Warnecke, saw the lymph vessels enlarge and believed lymph stasis to play an important part in the healing. Warnecke cites Forlanini as giving an interesting observation, indicating that in a well compressed lung no fresh tubercles could develop. He saw

a case of miliary tuberculosis which involved the entire noncompressed lung, while the collapsed parts of the other lung remained free from disease. Shingu (5) studied experimentally, by histological methods, the fate of carbon particles inhaled before and after artificial pneumothorax and hydrothorax in rabbits. He found that in control animals the carbon was uniformly distributed, slight differences, however, being discernible, since the right lung was somewhat more pigmented than the left and the upper more than the middle or lower lobes. If the carbon was inhaled before compression the uncollapsed lung was found to be lighter than the collapsed lung and it contained less carbon. He concluded that the respiring lung has freed itself of the carbon through the bronchi while this was impossible in collapsed lungs. The bronchial glands were the same on both sides. If pneumothorax was first performed and carbon then inhaled, the completely collapsed lung was free from it; but if only partially collapsed, it contained some carbon though the normal lung contained most of it. He drew only reserved conclusions from these experiments, especially regarding tuberculosis, and pointed out that tubercle bacilli may be retained in the collapsed lung and thus make possible an increase in the number sent through the lymphatics to the glands, though this may be counter-balanced by the respiratory rest which inhibits a further output of bacilli into the air passages, and the action of the lymph stasis which hinders propulsion. He pointed out that in tuberculosis the expiration of tubercle bacilli is of little significance compared with the inhibition of development of the bacilli upon which, to so great an extent, healing is dependent.

In order to determine whether there is any difference between the blood content of collapsed and normal lungs, Bruns (6) studied this in rabbits in which he produced both closed and open pneumothorax. In open pneumothorax he examined the lungs in from ten seconds to ten minutes after the procedure and the closed pneumothorax cases were examined up to ninety-two days after compression. In open pneumothorax he found that the collapsed lung contained both relatively and absolutely less blood than the normal of the same animal and this also held true in closed pneumothorax. He also found a connective tissue increase in the collapsed lungs. In dogs, goats and rabbits there was an enlargement of the right ventricle as a result of artificial pneumothorax.

In an elaborate study of the circulation of the lung with the aid of his lung plethysmographic method, Cloetta (7) was unable to arrive at conclusions indicating that there was a diminished circulation in the com-

pressed lung. He repeated Bruns's experiments and could not find that the compressed lung contained less blood than the inflated in the inspiratory phase. He also pointed out that if the compressed lung did contain less blood than the inflated lung it would not indicate that the circulation through it was lessened. All his experiments seemed to indicate, if anything, a better circulation through the compressed lung. He showed the differences between the circulation in inspiratory and expiratory phases (the latter being greater) and their effect upon the carotid pressure. Microscopic evidence obtained by him not only corroborated functional and chemical studies but guaranteed the reliability of the entire plethysmographic method.

It is rather interesting that the effect of pneumothorax upon experimental pulmonary tuberculosis should not have been studied at an earlier date; but no reference was found in the literature indicating that such investigations had been carried out until that reported by Shaw (8) in 1919. His experiments are rather scanty, being performed on 5 rabbits, and they led him to the conclusion that the collapsed lung was more involved with tuberculosis, after either intravenous or intratracheal injection of tubercle bacilli. The first animal with artificial pneumothorax of the left side received tubercle bacilli intravenously and was killed seventeen days later, when the left lung was found to be tuberculous, while the remaining organs were normal. The second animal with artificial pneumothorax of the right side, received an intratracheal injection of tubercle bacilli and five days later on section revealed miliary tubercles throughout the lower lobe of the right lung, the rest of the animal being normal. The third animal without compression received tubercle bacilli intravenously and eight days later on section revealed miliary tubercles "throughout both lower lobes." The fourth animal with right pneumothorax, given an intravenous injection of tubercle bacilli, revealed twenty days later on section caseous areas in the middle and inferior lobes of the right lung (this lung still being collapsed), the other organs being normal. A duplicate of the fourth animal revealed seven days after infection a number of miliary tubercles in the right lung. If these observations of Shaw's with findings so opposite to the general conception on the effect of compression upon pulmonary tuberculosis are true they certainly would contraindicate the use of artificial pneumothorax, especially in early cases and probably in all cases, and for this reason a new and more elaborate investigation seemed justified. In the experiments to be reported rabbits were used exclusively, since of all the

usual laboratory animals available they were best suited for the production of either a one sided pneumothorax or hydrothorax (9); and by the intravenous injection of a uniform suspension of virulent human tubercle bacilli an exclusive and uniform pulmonary tuberculosis could be produced in them. They were also desirable in this case since Shaw carried out his experiments on rabbits.

The experiments to be reported were divided into two sets. In the first set pneumothorax was produced, either left or right sided, by the injection of from 75 to 100 cc. of nitrogen, depending upon the size of the animal, with a resultant final positive manometric reading (water) up to about +6 cm. In the second set hydrothorax was produced by the injection of from 75 to 85 cc. of sterile 7 per cent acacia in physiological saline solution. In the pneumothorax set there were 8 control rabbits in which no collapse was produced, 16 rabbits all collapsed twenty-four hours before the intravenous injection of the tubercle bacilli (8 on the right side and 8 on the left side), and 16 rabbits given an intravenous injection of tubercle bacilli and twenty-four hours afterwards 8 were collapsed on the right side and 8 on the left side. The hydrothorax set was identical to this except that there were only three-fourths as many animals in the lot. All of the rabbits received by intravenous injection 0.5 mgm. of a virulent culture 1851 of human tubercle bacilli in 3 cc. of 0.9 per cent salt solution, made into a uniform emulsion according to the method previously described by one of us (10) and used in virulence tests. The animals were killed at definite intervals (10, 19, 28 and 37 days in the case of pneumothorax and 10, 20 and 30 days in the case of hydrothorax) after infection when the distribution and character of the lesions were carefully observed.

Experiments

THE EFFECT OF PNEUMOTHORAX, INDUCED BEFORE AND AFTER INFECTION, UPON THE DISTRIBUTION AND TYPE OF TUBERCULOSIS IN RABBITS' LUNGS

All the animals in this set were infected by the intravenous injection of a uniform suspension of virulent human tubercle bacilli (0.5 milligram in 3 cc. 0.9% sodium chloride solution) culture 1851.

Animals killed ten days after infection

1. Controls.

Rabbit 1. Uniform distribution of pin-point translucent miliary tubercles throughout both lungs.

Rabbit 2. Findings identical to those in rabbit 1.

2. Right-sided compression before infection.

Rabbit 3. A marked right-sided pneumothorax was found by fluoroscopy shortly after compression. The animal was infected twenty-four hours after primary compression. A refill of nitrogen was made five days later. On section the right lung was compressed and there was a uniform distribution of pin-point miliary tubercles throughout both lungs.

Rabbit 4. An exact duplicate of rabbit 3 revealed on section a slight compression of the right lung and a uniform distribution of pin-point miliary tubercles throughout both lungs.

3. Left-sided compression before infection.

Rabbit 5. A marked left-sided pneumothorax was found by fluoroscopy shortly after compression. The animal was infected twenty-four hours after primary compression. No refills were made. On section the left lung still showed some compression and there was a uniform distribution of pin-point translucent miliary tuberles throughout both lungs.

Rabbit 6. An exact duplicate of 5. Snuffles complicated the picture on section but the lower lobes of both lungs were involved and revealed a uniform distribution of the tuberculosis.

4. Right-sided compression after infection.

Rabbit 7. Revealed a good right-sided pneumothorax immediately after compression. The animal was infected twenty-four hours before compression. On section it revealed a uniformily distributed miliary tuberculosis throughout both lungs.

Rabbit 8. An exact duplicate of 7, with the identical findings on section.

5. Left-sided compression after infection.

Rabbit 9. Revealed a good left-sided pneumothorax shortly after compression. On section the miliary tuberculosis was uniformly distributed throughout both lungs.

Rabbit 10. Complicated by snuffles.

Animals killed nineteen days after infection

1. Controls.

Rabbit 11. Both lungs uniformly involved with pin-point to pin-head translucent miliary tubercles throughout.

Rabbit 12. Findings identical to rabbit 11.

2. Right-sided compression before infection.

Rabbit 13. Fluoroscopy revealed a marked right-sided pneumothorax shortly after compression. The animal was infected twenty-four hours after

compression. On section there was a uniform distribution of pin-point to pin-head miliary tubercles throughout both lungs.

Rabbit 14. A duplicate of 13 revealed an identical uniform distribution.

3. Left-sided compression before infection.

Rabbit 15. Died on the sixteenth day after infection revealing in both lungs a uniform distribution of miliary tubercles.

Rabbit 16. Fluoroscopy revealed a marked left-sided pneumothorax shortly after compression, and twenty-four hours later the rabbit was infected. On section there were found miliary translucent pin-point to pin-head tubercles scattered equally throughout both lungs.

4. Right-sided compression after infection.

Rabbit 17. Marked right-sided pneumothorax shortly after compressed seen by fluoroscopic examination. Animal infected twenty-four hours before compression. Section revealed a uniform distribution of pin-point to pin-head miliary tubercles throughout both lungs.

Rabbit 18. Exact duplicate of 17 as to treatment. On section the right lung seemed to be slightly less involved than the left lung.

5. Left-sided compression after infection.

Rabbit 19. Nitrogen gas injected apparently into pericardial sack as revealed by subsequent fluoroscopy. Section revealed a uniform distribution of miliary tuberculosis throughout both lungs.

Rabbit 20. Marked left-sided pneumothorax shortly after compression revealed by fluoroscopy. On section there was found a uniform distribution of miliary tubercles (pin-point to pin-head) throughout both lungs.

Animals killed twenty-eight and thirty-seven days after infection

On account of the similarity of the results obtained at these intervals, especially as regards the distribution of the tuberculosis and types of tubercles found in the right and left lungs, it seems unnecessary to detail the autopsy findings on these animals. The tuberculosis at intervals of 28 and 37 days had progressed further than those of the 10 and 19 days intervals, the tubercles varying in size but as a whole being larger at the longer intervals. Included in the 28 day interval there were 10 animals distributed in sets of two as detailed in the 10 and 19 day intervals; and except for a single exceptional finding there was noted no difference between the controls and the animals collapsed on the right or left side, either before or after infection. Throughout this entire series attention was also paid to the amount of infection in the controls, as compared to those compressed on either the right or left side. Here the individual variations were found to be greater between

animals of the same set than the variations noted between the infections in the right and left lung of the same animals; but there was again noted no consistent difference between the involvement found in the lungs of the animals not compressed (controls) and these having a one-sided compression.

THE EFFECT OF HYDROTHORAX PRODUCED BEFORE OR AFTER INFECTION UPON THE DISTRIBUTION AND TYPE OF TUBERCULOSIS IN THE RABBITS LUNGS

In this set of experiments, which is practically a duplicate of the pneumothorax set, the lungs were compressed by means of 75 to 85 cc. of sterile 7 per cent acacia in 0.9 per cent sodium chloride solution, a concentration which approximates that attained in the pleura when stronger or weaker acacia solutions are injected.[1] The series gave results exactly similar to those obtained when compression was done by pneumothorax, and for this reason results will be merely given in brief in tabular form, although it is admittedly difficult to devise a system of marking to suit the occasion (table 1).

The fairly uniform distribution of the tuberculosis in the rabbit's lungs, regardless of whether the right or left lung had been compressed and whether collapse was occasioned before or after the intravenous injection of the tubercle bacilli, made it seem desirable, in view especially of Bruns's observations, to obtain further corroboratory evidence that particles intravenously injected in fine emulsion were uniformily distributed in both the collapsed and normal lung. Since also in the tuberculosis experiments twenty-four hours elapsed between the collapse and the infection, the evidence would be more convincing provided the fine emulsion were injected within a short time after compression. Since tubercles do not make their appearance macroscopically in the lungs of rabbits for at least a number of days after intravenous injection it seemed desirable to use some colored insoluble material, which could be made up into a very fine emulsion suitable for intravenous injection and would be immediately visible, or could be made visible by contact with a suitable chemical reagent. Carbon particles were considered; but on account of the natural presence of anthracosis in animals and the difficulty of making suitable suspensions for intravenous injection they were not used. A heavy suspension of starch was also considered since it could be colored blue by prolonged immersion of the lungs in a weak iodine solution. This was used; but it was found to be less suitable than either of the following two substances. The best results were obtained by the use of Prussian blue, which was washed free from ferric chloride

[1] These data will be given in full in a subsequent publication.

TABLE 1

The effect of pulmonary compression by fluid upon tuberculosis in the lung of the rabbit

TIME OF SECTION AFTER INFECTION	COMPRESSION BEFORE OR AFTER INFECTION	SIDE OF COMPRESSION	NUMBER OF ANIMAL	TUBERCULOUS INVOLVEMENT	
				Right	Left
Ten days	Controls		1	3^1	3^1
			2	3^1	3^1
	Before	Right	3	3^1	3^1
			4	3^1	3^1
	Before	Left	5	3^1	3^1
			6	3^1	3^1
	After	Right	7	3^1	3^1
			8	3^1	3^1
	After	Left	9	3^1	3^1
			10	3^1	3^1
Twenty days	Controls		11	3^2	3^2
			12	3^2	3^2
	Before	Right	13	3^2	3^2
			14	0	0
	Before	Left	15	3^2	3^2
			16	3^2	3^2
	After	Right	17	3^2	3^2
			18	3^2	3^2
	After	Left	19	3^2	3^2
			20	3^2	3^2
Thirty days	Controls		21	3^3	3^3
			22	3^3	3^3
	Before	Right	23	3^2	3^2
			24	3^2	3^2
	Before	Left	25	3^3	3^3
			26	3^3	3^3
	After	Right	27	3^3	3^3
			28	snuffles	snuffles
	After	Left	29	3^3	3^3
			30	3^3	3^3

* Note: 0–3 gives the approximate relative number of miliary tubercles.

0 = no visible tubercles.

1 = 1–10 in entire lung.

2 = 10–100 in entire lung.

3 = over 100.

The exponents from 1–3 denote the approximate size of these tubercles.

1 = up to 0.5 millimetre in diameter.

2 = from 0.5 up to 1.0 millimetre in diameter.

3 = over 1 millimetre in diameter.

Of course this arbitrary grading system cannot accurately depict the findings since when many tubercles over 1 millimetre in size were found there were also some under 0.5 millimetre.

TABLE 2

Results of the intravenous injection of a suspension of Prussian blue, starch and Scarlet R. into rabbits with a right side pneumothorax

SUBSTANCE INJECTED	TREATMENT OF LUNGS	ANIMAL	TIME INTERVAL BETWEEN INJECTION AND DEATH OF ANIMAL	RESULTS OF LUNG EXAMINATION
Prussian blue 2 cc., 1 to 5 suspension in 0.9 per cent sodium chloride solution, given intravenously	Trachea tied before opening chest. Formalin injected into trachea and specimen suspended in formalin	1	Immediately	Prussian blue uniformly distributed throughout both the right (compressed) and the left lung
		2	1 minute	Prussian blue uniformly distributed throughout both the right (compressed) and the left lung
		3	2 minutes	Prussian blue uniformly distributed throughout both the right (compressed) and the left lung, seemingly deeper in color than immediately or after one minute
		3	3 minutes	Prussian blue uniformly distributed throughout both the right (compressed) and the left lung, seemingly deeper in color than immediately or after one minute
		5	5 minutes	Prussian blue uniformly distributed throughout both the right (compressed) and the left lungs, but the color is perceptibly lighter than in the above four animals
		6	30 minutes	Prussian blue is found in discrete spots uniformly distributed throughout both the right (collapsed) and the left lung. There is a distinct disappearance of the blue pigment
Starch suspension 2 cc., 1 to 10 in 0.9 per cent sodium chloride solution, given intravenously	Trachea tied before opening chest, a weak aqueous solution of iodine injected in the trachea and the specimen suspended in the same solution	7	5 minutes	The blue iodine starch granules were uniformly distributed throughout both the right (compressed) and left lungs

TABLE 2—*Continued*

SUBSTANCE INJECTED	TREATMENT OF LUNGS	ANIMAL	TIME INTERVAL BETWEEN INJECTION AND DEATH OF ANIMAL	RESULTS OF LUNG EXAMINATION
Scarlet R suspension in 0.9 per cent sodium chloride solution	Trachea tied before opening chest, all other tissues removed, lungs weighed and analyzed for Scarlet R. colorimetrically after thorough extraction with alcohol	8	30 minutes	The total alcoholic extract was determined by comparison with a colorimetric standard. The right weighed 5.00 gm. and contained 1.9 mgm. Scarlet R or 0.38 mgm. per gm. of lung. The left lung weighed 3.62 gm. and contained 1.4 mgm. Scarlet R or 0.39 mgm. per gm. of lung
		9	2 hours	The Scarlet R was determined colorimetrically as above. The right lung weighed 4.96 gm. and contained 0.06 mgm. of Scarlet R or 0.012 mgm. per gm. of lung. The left lung weighed 3.45 gm. and contained 0.045 mgm. of Scarlet R or 0.013 mgm. per gm. of lung

and potassium ferrocyanide, from which it was prepared, by three additions of 0.9 per cent sodium chloride solution, after which it was centrifugated, the supernatant fluid decanted and the precipitate again washed and finally suspended in about 5 times its volume of saline solution. About 2 cc. of this suspension was given intravenously. A good suspension of Scarlet R was also found suitable, not because it would give a direct color to the lungs, but because it could be quantitatively extracted by means of alcohol. A suspension of Scarlet R was made by cautiously diluting a strong ether solution of the dye with saline solution and shaking when the Scarlet R would precipitate out into a fine suspension and could be centrifugated to remove the large particles, leaving the smaller particles in suspension for injection. A series of 9 rabbits were given 100 cc. of nitrogen into the right pleural cavity and within thirty minutes thereafter were given intravenous injections of suspensions of Prussian blue, starch and Scarlet R. The result of the pulmonary findings are given in table 2.

An examination of table 2 reveals two interesting facts; first, that suspended particles injected intravenously into rabbits with a right-sided

pneumothorax, produced a short time before intravenous injection, are uniformly distributed throughout both lungs; and second, on account of the partial solubility of two of these substances, Prussian blue and Scarlet R, there was found also to result a disappearance of these substances from both lungs equally and uniformly. These two facts strongly indicate that such circulatory disturbances as may result from compression of the lung in the rabbit certainly cannot be very marked. They also explain the uniform distribution of tuberculosis in the lungs of rabbits after intravenous injection in normal and pneumothorax animals.

SUMMARY AND CONCLUSIONS

1. One-sided artificial pneumothorax or compression of one of the lungs of the rabbit by means of fluid, artificial hydrothorax, has no visible macroscopic influence upon the number or type of the tuberculous lesions resulting from the intravenous injection of virulent human tubercle bacilli, regardless of whether the compression is occasioned on the right or the left side, or whether it is occasioned a day before or a day after the intravenous injection of the tubercle bacilli. These results disagree with those found by Shaw who maintains that compression favors the development of the tuberculosis in the compressed as compared to the other lung. There were also noted no differences between the number or type of the tuberculous lesions in animals with one lung compressed as compared with normal animals, not compressed, although the differences between the different animals of the same series receiving the same intravenous injections of tubercle bacilli was greater than the differences found between the two lungs of the same animal.

2. Suspensions of Prussian blue, Scarlet R and starch, injected intravenously into rabbits shortly (within one-half hour) after a right-sided closed pneumothorax, were found uniformly distributed throughout the lungs immediately after injection and up to two hours thereafter. The gradual disappearance of Prussian blue within that time occurred uniformly on both sides and would not tend to support Bruns, who maintained that the circulation was lessened in the compressed lung as opposed to Cloetta who maintained an equal (or even better circulation) in the pneumothorax lung as compared with the other lung.

REFERENCES

(1) An interesting and complete review of artificial pneumothorax is given by Rist, E.: Quart. Journ. Med., 1912–1913, vi, 259, from which these historical notes are taken.

(2) Grätz, F.: Der Einfluss des Künstlichen Pneumothorax auf die tuberkulöse Lung. Beitr. z. Klin. d. Tuberk., 1908, x, 249.

(3) Warnecke: Beitrag zur pathologischen Anatomie des künstlichen Pneumothorax. Ibid., 1910, xvi, 171.

(4) Kistler, E.: Beitrag zur pathologischen Anatomie des küntslichen Pneumothorax. Ibid., 1911, xix, 459.

(5) Shingu, S.: Beitrage zur Physiologie des künstlichen Pneumothorax und seiner Wirkung auf die Lungentuberkulose. Ibid., 1908, xi, 1.

(6) Bruns, O.: Über Folgezustände des einseitigen Pneumothorax. Ibid., 1909, xii, 1.

(7) Cloetta, M.: Über die Zirkulation in der Lunge und deren Beeinflüsung durch Über- und Unterdruck. Arch. f. exp. Path. u. Pharm., 1911, lxvi, 409.

(8) Shaw, F. W.: A contribution to predisposing factors in pulmonary tuberculosis. Amer. Rev. Tuberc., 1919, iii, 410.

(9) Bruns, O.: Loc. cit.

(10) Corper, H. J.: The virulence of the tubercle bacilli isolated from the sputum. Jour. Infect. Dis., 1918, xxiii, 500.

HYPERNEPHRECTOMY AND EXPERIMENTAL TUBERCULOSIS

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We have undertaken some experiments, with the hope of giving support to clinical observations, such as those of Sergent (1) upon the relation between adrenal function and tuberculosis. The first of these studies, here reported, deals with the removal of one adrenal in guinea pigs, and the effect of this operation on resistance to a subsequent inoculation with tubercle bacilli.

Series 1. In March, 1919, after some preliminary work to determine the best technique, guinea pigs 1 and 2 were operated upon, the left adrenals being removed through a vertical incision below the costal margin, about in the nipple line. They recovered rapidly from the operation and at no time after the first day or two showed any marked weakness. One month later, they, and two normal controls (A and B) were inoculated in the right nipple area with about 200 tubercle bacilli from a virulent culture. The bacilli were counted by the method of Barber (2) as employed in previous experiments (3).

Pig 1 died of intercurrent disease six weeks after inoculation. Pigs 2 and A were therefore killed and autopsied also. Pig B was kept alive for some months and remained well. The findings are given in table 1.

Series 2. In April, 1919, pig 3 was operated on, the left adrenal being removed as before. The remaining members of the series, pigs 4 to 12, were operated on in August and September. Like the pigs of the first series, they recovered quickly and without characteristic signs of adrenal insufficiency· On December 6, these 10 pigs and 10 normal controls, (C to M), were inoculated in the right groin with 0.05 cc. of a very weak emulsion of a culture of tubercle bacilli of exceptionally vigorous growth in culture, but known to be virulent. However, only two pigs, 11 and K, developed tuberculosis. Control C became sick from other disease and was killed and autopsied five weeks after inoculation. Pigs 11 and K, also 3, 5 and D, were killed and autopsied two weeks later. The findings are given in table 2.

On February 24, the remaining members of the series, and an extra control (N), were reinoculated in the left groin with 0.05 cc. of a somewhat stronger emulsion of another culture. Another control (O) was given 0.5 cc. of the same emulsion. Tables 3, 4 and 5 give the results.

TABLE 1

Autopsy findings

PIG NUMBER	WEEKS AFTER INOCULATION	RIGHT INGUINAL NODES	LEFT INGUINAL NODES	SPLEEN	LIVER	LUNGS	BRONCHIAL NODES
1	6	+?					
2	6	+++					
A	6	+++		+++	+		+
B	16						

TABLE 2

Autopsy findings

PIG NUMBER	WEEKS AFTER INOCULATION	RIGHT INGUINAL NODES	LEFT INGUINAL NODES	SPLEEN	LIVER	LUNGS	BRONCHIAL NODES	WEIGHT OF RIGHT ADRENAL
								grams
3	7							0.4
5	7							
11	7	+++	+++	++++	++++	++	++	0.5
K	7	+		++++	++++	+++	+++	
D	7							0.3
C	5							

TABLE 3

OPERATED GUINEA PIGS				CONTROLS			
Pig number	Left inguinal nodes enlarged, number of days after inoculation			Pig number	Left inguinal nodes enlarged, number of days after inoculation		
	13	15	18		13	15	18
4		+		E		+	
6		+		F		+	
7	+			G			+
8		+		H			+
9	+			J		+	
10		+		L			+
12		+		M		+	
				N		+	
				O		+	

TABLE 4

GROUP	AUTOPSY FINDINGS									
	Pig number	Weeks after inoculation	Right inguinal nodes	Left inguinal nodes	Spleen	Liver	Lungs	Bronchial nodes	Weight of right adrenal	Weight of left adrenal
									grams	
1	4	3		+++					0.4	
	8	3		+++	+	+			0.4	
	10	3		+++	+	+		+	0.5	
	F	3		+++	+	+		+		0.3
	L	3		+++	++	+		+	0.3	
	N	3		+++	+			+	0.3	
2	7	4	+	++++	++	+++		+	0.4	
	9	4		+++	++	++		++	0.5	
	E	4	+	++++	++	++		+	0.3	
	M	4	+	++++	+++	+	+	++		
3	6	6	+	++++	+++	+		+	0.6	
	12	6	++	++++	+++	++	+	+++	0.6	
	G	6	+	+++	+++	+	+	+	0.4	0.4
	H	6	+	++++	++++	++	+	++	0.3	0.3
	J	6	+	+++	++++	++	+	++	0.4	0.4
	O	6	+	++	+++	+		+		

Average weight of pigs, 750 gms.

TABLE 5

	AVERAGE WEIGHT OF RIGHT ADRENAL
	grams
Normal	0.3
Operated pigs without tuberculosis	0.4
Control pigs, 3 weeks after inoculation	0.3
Operated pigs, 3 weeks after inoculation	0.43
Control pigs, 4 weeks after inoculation	0.25
Operated pigs, 4 weeks after inoculation	0.45
Control pigs, 6 weeks after inoculation	0.37
Operated pigs, 6 weeks after inoculation	0.6
All control pigs	0.33
All operated pigs	0.48

SUMMARY AND CRITICISM

Under the conditions of the experiment there was no apparent difference in resistance to tuberculosis in guinea pigs from which the left adrenal had been removed, as compared with control pigs, though the primary palpable enlargement of inguinal nodes appeared a trifle sooner

on the average in the operated pigs than in the controls. There was the usual compensatory hyperplasia of the remaining adrenal, the average weight being 0.48 gm. compared with 0.33 gm. in the controls. The adrenal weights were considerably higher in the pigs autopsied six weeks after successful inoculation than in those autopsied three or four weeks after, or in those without any tuberculosis; and this was true in the control pigs as well as in the operated ones, and in the latter did not correspond to the time elapsed since operation. This suggests a demand for increased adrenal function in tuberculosis, and calls for further experiment with a larger number of pigs and a more complete record of body weights.

As a result of this and other experiments, we are convinced that the emulsion method of inoculation is too inaccurate and too likely to result in giving a dose so far beyond the toleration point as to overwhelm any possible variations in resistance. These variations will only be detected, we believe, by giving very minute counted doses. There are chances of error in this method, too, but they are less than in any other.

It is obvious that this experiment does not elucidate the question of the relation of adrenal insufficiency to resistance in tuberculosis, as no insufficiency appeared to be produced.

REFERENCES

(1) Sergent: Études cliniques sur la tuberculose, 1908–1918. Paris, 1919.
(2) Barber: On heredity in certain microörganisms. The Kansas University Science Bulletin, iv, no. 1, March, 1907.
(3) Webb, Williams and Barber: Immunity production by inoculation of increasing numbers of bacteria beginning with one living organism. Journ. Med. Res., xx, no. 1, January, 1909.

ADRENALIN HYPERSENSITIVENESS IN DEFINITE AND UNPROVED PULMONARY TUBERCULOSIS

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An attempt is made in this paper to present a study of cases of pulmonary tuberculosis and of cases sent to us with a diagnosis of pulmonary tuberculosis which show a hypersensitiveness to injections of adrenalin. In a number of cases previously diagnosed as pulmonary tuberculosis we were unable to prove its existence. These are designated hereafter as nontuberculous.

The adrenalin tests were begun shortly after the appearance of an article by Goetsch (1) and were first carried out at Trudeau Sanatorium by Dr. Foster Murray, under the direction of Dr. Goetsch, whose services fortunately were available to us. Later, Mr. N. C. Nicholson and Dr. Goetsch together studied the adrenalin reaction in a series of cases and their observations were jointly published later (2). Since then too, the test has been a routine procedure for all cases entering the Trudeau Sanatorium.

The technique in all cases was that given by Goetsch, which is as follows: The patient is put to bed the evening before the day of the test and is kept there until after the test has been completed. During this time all excitement or stimulation of any kind is kept from the patient. Mentally he is calmed and assured that the test is entirely free from danger or ill consequences. Preliminary to the subcutaneous injection of 0.5 cc. of 1–1000 solution of fresh adrenalin, the systolic and diastolic blood pressures, pulse and respiration are taken at two and one-half minute intervals for two or three observations and notes made of the patient's vasomotor state and symptoms, such as pallor, flushing, sweats, tremor, nervousness, anxiety, etc.

The subcutaneous adrenalin injection is then made and at two and one-half minute intervals thereafter the same observations mentioned above are made for the following half-hour or more, until the reaction is completed.

When characteristically positive, the reaction is marked by a primary rise of systolic pressure (of 10 mm.) and a fall of diastolic pressure, with increase of pulse and respiratory rates. At this time, too, there occurs pallor, followed by flushing and localized sweats. Tremor becomes marked, and the patient is apt to laugh or cry without reason. In addition to the tremor there may be gross muscular contractions and especially exaggeration of the symptoms of which the patient has complained for some time.

Following the increased systolic pressure of 10 mm. or more, there is a fall in systolic and rise in diastolic pressure, with an abatement of symptoms and a tendency to calmness or drowsiness. Later a secondary reaction, essential to a positive reaction, occurs, which is milder than the primary but which is characterized by the same blood pressure changes. After the secondary reaction, the patient's condition gradually returns to normal. He may at first feel sleepy and all worn out, but gradually his feeling of strength and well being return. Without the secondary reaction the test is not positive.

The following is a positive reaction occurring in a case of inactive pulmonary tuberculosis, complicated by adenomata of the thyroid (proved at operation), in which marked improvement of symptoms followed their removal. (See page 611.)

The reaction. The present series comprises 260 cases under observation at the Trudeau Sanatorium. Of these, 44 (17 per cent) reacted to the test. Pulmonary tuberculosis could not be demonstrated in 16 (36 per cent) and was demonstrated in 28 (64 per cent) of these cases.

There were 216 cases that did not react to the adrenalin. Pulmonary tuberculosis could not be demonstrated in 39 (18 per cent) of these.

The reaction in pulmonary tuberculosis and nontuberculous cases. Of the 55 cases in which pulmonary tuberculosis could not be proved, 16 (29 per cent) reacted to adrenalin, and of the 205 definitely tuberculous cases 28 (14 per cent) reacted to adrenalin, so that the reaction to adrenalin was about twice as frequent in the nontuberculous as in the tuberculous cases.

The adrenalin reaction and activity of the tuberculous process. In 71 instances the pulmonary lesion was accompanied by symptoms of activity, and in 8 of these cases (11 per cent) a reaction to adrenalin took place. Symptoms of activity were absent in 134 cases. Of these, 17 had a positive adrenalin reaction (13 per cent). It may be that in a number of the cases reacting to adrenalin the rapid pulse and slight ele-

Case 5103

TIME	PULSE	RESPIRATION	BLOOD PRESSURE	REMARKS
10:15	78	18	106/70	Hands warm and moist. Feet cool and dry. Lips fairly pale. Slight, very fine tremor. No subjective sensations. No abnormal neck pulsations.
10:17½	80	22	100/70	
10:20	84	24	100/70	
10:22½	80	14	100/68	
10:25	Adrenalin 0.5 cc.			
10:27½	78	24	102/70	Fingers colder. +
10:30	74	18	104/70	Feet colder and moist. +
10:32½	82	16	110/78	Sighs deeply. Expirations quite rough.
10:35	90	22	116/80	Very restless. Says, "Its hard to lie still." Tosses head about from side to side.
10:40	88	24	124/80	Lips have become bright red. Says, "You are all so quiet." Feet colder and moist. Tremor quite marked. ++
10:45	96	24	114/74	Feels "keyed up." Legs feel "trembly." Restless. Throat and lips dry. Difficult to swallow. Becomes petulant about stillness of observer and nurse. Pulls at hair. "Feel as though my back were braced tight."
10:50	94	20	120/72	Tremor. ++++
10:55	94	30	128/72	Feels nervous and tense. "Am I saying crazy things?" "This is the craziest thing I ever had happen. Never before had to lie still. My back is funny."
11:00	98	20	130/66	Pants. Licks lips with tongue frequently. Pulse irregular. ++. Feet warmer, moist. Hands warmer. Very restless. "Cogwheel" expiration. Whole body trembles so as to shake the bed. Respiration labored and irregular.
11:05	100	30	130/72	Hands markedly warmer.
11:10	104	30	126/80	Tremor of face muscles. ++. Convulsive jerks of sacrospinal muscles and other of the large muscle groups. Lips trembling. "I dont like you any more. Can't this be stopped in some way? I believe this is all imagination. Make silly out of me. I guess you are disgusted. I am." Tosses about.
11:15	104	36	124/74	
11:20	96	30	124/62	Hands and feet markedly colder.
11:25	98	40	124/68	Whole body trembles. ++. Slight malar flush. Hands and feet warmer.
11:35	98	36	114/58	Marked malar flush now.
11:45	98	30	114/70	Tremor still present: slight and fine.
11:55	98	28	112/70	Hands and feet warmer. ++

Impression: Response to adrenalin quite marked and positive, both objectively and subjectively. Marked degree of hyperthyroidism. +++.

vation of temperature, considered as symptoms of activity of the tuberculosis, were caused by hyperthyroidism or some other endocrine disturbance.

The X-ray showed a condition interpreted as apt to undergo a change for better or worse (focal activity) in 161 instances. Of these only 17 (10 per cent) reacted to adrenalin. When the X-ray showed apparently no focal activity, 11 (25 per cent) of 44 cases reacted to adrenalin. The complement fixation test was positive in 104 cases, of which 17 (16 per cent) reacted to adrenalin, and the fixation was negative in 101 cases, of which 11 (19 per cent) reacted to adrenalin. There were symptoms of activity and the X-ray showed a condition interpreted as susceptible to change for better or worse, and the complement fixation was positive in 40 cases. In other words, there were evidences of activity from the symptoms, X-ray and complement fixation in 40 cases. Of these, 4 (10 per cent) reacted to adrenalin.

When there was no evidence of tuberculous activity as mentioned above, as was the case in 26 cases, 5 cases (19 per cent) reacted to adrenalin. So that it may be said that the inactive cases reacted a little more frequently than the active tuberculous cases.

The adrenalin reaction and tubercle bacilli. Of the 104 cases having tubercle bacilli in their sputum, 11 (10 per cent) reacted to adrenalin, whereas, of the 101 cases that had no tubercle bacilli in their sputum, 17 (17 per cent) reacted to adrenalin. Therefore the adrenalin reaction occurred more often in those cases not having tubercle bacilli at the time of the test.

The adrenalin reaction and hemoptysis. A teaspoonful or more of blood was considered as an hemoptysis. A history of hemoptysis occurred in 65 cases and the adrenalin test was positive in 11 (17 per cent). There was no history of hemoptysis in 140 cases, of which 17 (12 per cent) reacted to adrenalin.

The adrenalin reaction and pleurisy. A history of pleurisy with effusion occurred in only 9 instances, all of which failed to react to adrenalin. A history of dry pleurisy occurred in 87 cases, of which 12 (14 per cent) reacted to adrenalin. There was no history of pleurisy in 109 cases, 16 (15 per cent) of which reacted to adrenalin.

The adrenalin reaction and extent of lesion by X-ray. Thirty cases showed an extent of the lesion by X-ray equivalent to or less than the area of the lung above the second chondrosternal junction of one side. Of these, 8 (27 per cent) reacted to adrenalin. Forty-seven cases had a

total area involved greater than that above mentioned, but not greater than the lung area above the third chondrosternal junction of one side. Of these, 7 (15 per cent) reacted to adrenalin. A more extensive lesion than the above was found in 118 cases. Of these, 11 (9 per cent) reacted to adrenalin. It would seem therefore that a positive adrenalin reaction occurred less and less frequently as the extent of the lesion had progressed.

The subcutaneous tuberculin test and adrenalin reaction. Twenty tuberculous cases in this series were given the subcutaneous tuberculin test. The test was positive in 15 instances, of which 4 (26 per cent) reacted to adrenalin. The subcutaneous tuberculin test was negative in 5 instances, of which 1 (20 per cent) reacted to adrenalin. The susceptibility to tuberculin subcutaneously had apparently no direct relation to the susceptibility to adrenalin in the tuberculous cases.

Of the nontuberculous cases, 36 reacted to the subcutaneous tuberculin test. Of these, 9 (25 per cent) reacted to adrenalin. Of the 15 nontuberculous cases not reacting to tuberculin, 6 (40 per cent) reacted to adrenalin. Apparently, in the nontuberculous cases, susceptibility to tuberculin is accompanied by a lessened susceptibility to adrenalin.

In this series there were also 5 cases of tuberculous colitis (X-ray diagnosis), all of which failed to react to adrenalin. One case with Pott's disease which had had a previous thyroidectomy reacted to adrenalin. Of four cases of lues, one with the central nervous system involved (spinal fluid Wasserman 4 plus) reacted to adrenalin. The other three failed to react.

SUMMARY

In a series of 260 cases there were 205 with pulmonary tuberculosis. Of the tuberculous cases, 14 per cent reacted to adrenalin. Of the nontuberculous cases, 29 per cent reacted to adrenalin. When there was evidence of tuberculous activity, as shown by symptoms, X-ray or complement fixation, 10 per cent reacted to adrenalin. And when there were no evidences of tuberculous activity from 13 per cent to 19 per cent reacted to adrenalin.

When tubercle bacilli were present in the sputum 10 per cent reacted to adrenalin, and when tubercle bacilli were absent 17 per cent reacted to adrenalin.

In 17 per cent of the cases, having a history of hemoptysis of a dram or more, the adrenalin reaction was positive.

In no case having a history of pleurisy with effusion was the adrenalin test positive. When a history of dry pleurisy occurred, the reaction was positive in 14 per cent.

When the disease was of limited extent (P. i) 27 per cent reacted to adrenalin; when of moderate extent (Pc. ii) 15 per cent reacted, and when more extensive (Pc. iii) 9 per cent reacted to adrenalin.[1]

When the subcutaneous tuberculin test was positive in the tuberculous cases 26 per cent reacted to adrenalin, and when the subcutaneous tuberculin test was negative 20 per cent reacted to adrenalin.

In the nontuberculous 25 per cent of those reacting to tuberculin reacted to adrenalin, and 40 per cent of those not reacting to tuberculin reacted to adrenalin.

None of the tuberculous colitis cases reacted to adrenalin.

One case of Potts disease did react. It also had had a previous thyroidectomy.

One of four lues cases reacted to adrenalin, and the central nervous system was involved with lues in this case.

CONCLUSIONS

1. The adrenalin reaction was twice as frequent in the nontuberculous as in the tuberculous cases (14 per cent and 29 per cent respectively).

2. Activity of the pulmonary focus, as determined by symptoms, played little if any part in occurrence of the adrenalin reaction (11 per cent as against 13 per cent).

3. Adrenalin hypersensitiveness apparently has no direct relation to the occurrence of a positive or negative complement fixation for tuberculosis (16 per cent and 19 per cent respectively).

4. Presumptive inactivity as interpreted from the X-ray was accompanied by adrenalin hypersensitiveness about two and one-half times as often as when activity was present.

5. The occurrence of tubercle bacilli seemed to be associated with a less frequent adrenalin reaction than when tubercle bacilli were absent (10 per cent and 17 per cent respectively).

[1] Pc. i. A definite parenchymatous X-ray lesion of a total extent not greater than the area of the lung above the upper level of the 2nd chondrosternal junction of one side.

Pc. ii. A definite parenchymatous X-ray lesion of total extent greater than Pc. i, but not greater than the lung area above the upper level of the 3rd chondrosternal junction of one side.

Pc. iii. A definite parenchymatous X-ray lesion greater than under Pc. ii.

6. The occurrence of a history of hemoptysis or of dry pleurisy seemed to bear no relation to the adrenalin reaction (17 per cent and 14 per cent respectively).

7. No case with a history of pleurisy with effusion reacted to adrenalin.

8. As the extent of disease becomes greater, the tendency to react to adrenalin apparently diminishes (27 per cent, 15 per cent, 9 per cent).

9. Susceptibility to tuberculin subcutaneously has apparently no relation to adrenalin hypersensitiveness, when tuberculosis is present. However, when pulmonary tuberculosis is absent, the adrenalin reaction is less apt to occur when there is tuberculin susceptibility.

10. Tuberculous colitis apparently does not promote adrenalin hypersensitiveness.

REFERENCES

(1) Goetsch, E.: Newer methods in the diagnosis of thyroid disorders. N. Y. State Jour. Med., xviii, 259.

(2) Nicholson, N. C., and Goetsch, E.: The differentiation of early tuberculosis and hyperthyroidism by means of the adrenalin test. Amer. Rev. Tuberc., 1919, iii, 109.

A PRELIMINARY REPORT OF A STUDY OF THE GOETSCH TEST[1]

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This study has been undertaken with the hope that out of it may come a more practicable test for the busy practitioner of to-day who may not have the time to devote to such a lengthy technique as is used by Goetsch. We think that we have had very satisfactory results from this test during its use of six months or a little longer. To men who have the time I would strongly advise their utilizing the test as laid down by Goetsch (1). I believe it is based on fundamental physiological principles and in the right hands will certainly give accurate results.

This preliminary report is upon a study of a series of 55 patients. These comprised 5 normal persons, 20 having tuberculosis in different stages but having no signs or symptoms of hyperthyroidism, 22 suspicious thyroids having tuberculosis and 6 tuberculous patients known to have hyperthyroidism. We have taken the following list of symptoms and signs of hyperthyroidism and have classified these finding in each case under the following headings: systolic blood pressure, diastolic blood pressure, pulse rate and quality, tremor, nervousness, palpitation, diuresis, temperature, respiration, apprehension, pupillary changes, vasomotor changes in face, hands and feet and sugar in the urine.

Systolic pressure. In each of the four classes of patients named above, systolic blood pressure rose practically the same number of points, reaching its maximum in the known cases of hyperthyroidism in nineteen minutes, having a secondary rise in forty-one minutes and remaining above normal for an average of an hour and seventeen minutes. In the 22 suspects the systolic blood pressure rose to its maximum in an average of eighteen minutes. In 4 suspects, the systolic blood pressure made a second rise in thirty-nine minutes and remained up for an average of fifty-nine minutes. The other 18 cases of this suspect group reached

[1] From a paper read before the Medical Society of the State of North Carolina, at its annual meeting in Charlotte, April 21, 1920.

their highest in thirteen minutes and returned to normal in twenty-three minutes. The 20 "no hyperthyroids" reached their maximum systolic blood pressure in an average of eleven and one-half minutes and returned to normal in an average of twenty-two minutes. The normal class reached its maximum systolic pressure in seven minutes and returned to normal in nineteen minutes.

Diastolic pressure. In the "known hyperthyroids" the diastolic blood pressure fell seventeen points, the maximum fall corresponding in minutes to the maximum rise in systolic pressure and continued in the same proportion until a normal level was reached by the systolic pressure. In the same 4 suspects mentioned above, the diastolic blood pressure fell sixteen points with the maximum systolic rise and returned to normal along with the systolic blood pressure. In the other 18 cases the diastolic blood pressure fell an average of nine and one-fifth points corresponding to the maximum systolic rise. It also returned to normal with the return of the systolic pressure to normal. The "no hyperthyroids" gave a diastolic fall of seven points which occurred at the same time as the maximum systolic increase and returned to normal therewith. The normals had a fall of six points in diastolic blood pressure corresponding to the maximum systolic rise and returned to normal with that of the systolic.

Pulse pressure. The "knowns" had a maximum increase of fifty-six points which pressure returned to normal with the systolic pressure. Four suspects had an increase of forty points while 18 suspects had an increase of twenty-nine and one-half points. The class of "no hyperthyroids" had an increase of thirty-one points while the normals had an increase of twenty-eight points.

Pulse. In the "knowns" the pulse rate increased an average of twenty-seven points. In 4 suspects there was no increase or decrease. In 18 suspects there was an average increase of fifteen points (maximum increase thirty, minimum increase six). The "no hyperthyroids" had an increase of fourteen points while the normals decreased three points per minute.

Quality. In the "knowns" the pulse became irregular, unequal and varied in volume. Fourteen suspects had the same type of pulse while 8 had a normal, full, well rounded pulse. In the "no hyperthyroids" the pulse was equal and regular in 16 cases but there was a slight irregularity and inequality present. In the normals the pulse was full and

bounding, no irregularity or inequality being detected except slight inequality in one case.

Tremor. Tremor, as well as nervousness, was increased in every case in the series. Palpitation was present in each case of the series and slight diuresis was present in all. A temperature increase of three-fifths of a degree in the "knowns" was found reaching its highest at the end of forty-seven minutes. It increased in all suspects, an average of two-fifths of a degree, reaching its highest in an average of forty minutes. In the "no hyperthyroids" the temperature was increased two-fifths of a degree, reaching its highest in forty-two minutes. In the normals the temperature was increased an average of one-fifth of a degree, reaching its highest in forty-six minutes.

Respiration. In the "knowns" this was increased an average of five points. In 6 suspects it increased an average of four points. In 16 suspects it increased an average of two points. In the "no hyperthyroids" it increased an average of one point and in the normals decreased an average of one and one-half points.

Apprehension. This was increased in every case of the series.

Pupillary changes. These changes were present in the whole series though in the 6 "knowns" and in 3 suspects there were frequent pupillary changes. In all others there was a primary slight dilatation followed by an early return to normal.

Vasomotor changes. These were present in the hands, feet and face of the entire series.

Sugar in the urine. None was found in any specimen.

Conclusion. As yet I do not consider this small amount of work reported upon as sufficient evidence for warranting any definite conclusions. However, if future studies substantiate these findings, we will find that the differential diagnosis of tuberculosis and hyperthyroidism will be made easier for the general practitioner when after the subcutaneous injection of adrenalin he finds, between fifteen minutes and one hour and thirty minutes after the injection, the following:

1. A systolic blood pressure, rising ten or more points and remaining above normal for fifty-five minutes or more.

2. Increased pulse rate of ten or more points per minute proportionate to the systolic rise.

3. An increase of pulse pressure of thirty-five or more points.

4. Pulse irregular and varying in volume.

5. An increase in respiratory rate of four or more points per minute.

6. Varying pupillary changes.

I firmly believe that this test can be made more practical for the general practitioner and for that reason we are diligently pursuing these studies at the State Sanatorium and hope to have at a future date some more definite and positive report to make.

REFERENCE

(1) Nicholson, N. C., and Goetsch, E.: The differentiation of early tuberculosis and hyperthyroidism by means of the adrenalin test. Amer. Rev. Tuberc., 1919, iii, 109.

PULMONARY FINDINGS DUE TO CIRCULATORY CHANGES

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Diminished circulatory force may cause lung alterations which vary from slight passive congestion to structural changes and edema. Between these extremes a wide range of changes exists, varying in proportion to the demand upon and the strength of the heart muscle. That gravity exaggerates this lung state is acknowledged, but gravity alone does not cause marked hypostasis unless some temporary or permanent circulatory defect exists.

Venous congestion causing hypostasis without structural changes in the lungs disappears, as a rule, under the reduction of cardiac work or increase in its efficiency.

Pulmonary irritation may occur in the form of bronchitis due to degeneration in some part of the circulatory system. The lung vessels become engorged and the surface epithelial cells infiltrated. In more advanced cases of congestion, interstitial changes occur, taking the form of engorged capillaries, hemorrhagic infarctions, the appearance of pigmented cells in the sputum, and the formation of fibrotic changes. These conditions represent the result of long-standing irritation.

Infarctions, the result of emboli from the heart and veins, or following abdominal or pelvic operations, give extensive pulmonary changes which, in turn, may be confused with pneumonia. These may occur on a pre-existing pulmonary stasis and add to the confusion.

The physical findings in passive lung congestions vary from weakened breath sounds with fine râles, especially basal, to impairment on percussion, accompanied by sibilant râles. The engorgement may reach the edematous stage whereby the air cells fill with fluid, causing an increase in dulness, and often disappearance of the râles. Congestion due to heart disease does not give rise to physical symptoms unless circulatory compensation fails or a superimposed infection takes place. Exagger-

[1] Read before the Clinical Section of the Sixteenth Annual Meeting of the National Tuberculosis Association, Saint Louis, Missouri, April 23, 1920.

ated and harsh breath sounds associated with fine râles are the usual early physical signs found in the congestive stage.

Repeated attacks of bronchitis, especially in winter, are a well-known accompaniment of cardiac lesions; and, in cases of doubt, the administration of digitalis will often result in a marked improvement in the bronchial irritation, indicating that a circulatory deficiency is at least an associated factor in causing or exaggerating the symptoms. In mitral stenosis the pulmonary changes are marked, and it is in this particular type of case that the fibrotic changes are most likely to appear. Hemoptysis in such cases has often led to confusion in differentiating between circulatory deficiency and pulmonary tuberculosis. With mitral insufficiency the pulmonary changes are, as a rule, more insidious and more liable to go from the congestive stage to edema, omitting the fibrotic type of pathology.

The heart, by its action on the adjacent lung tissue, sometimes produces respiratory sounds of various types. Especially is this true if pleuropericardial adhesions are present. These sounds may be interrupted or influenced by the respiratory and cardiac rhythm, and sometimes affected by changes in position. Such sounds are most frequently heard near the apex and along the left cardiac border and are perhaps found more frequently in tuberculous cases. Systolic murmurs in the subclavian region may be considered in the same class.

In some instances of extreme cardiac enlargement or pericardial effusion, pronounced expiratory sounds, bronchial in character, due to the underlying compressed lung tissue, may be heard over the back of the left base. These signs may cause confusion in differentiating between pericardial or pleural effusion and pneumonia.

Lung changes in passive congestion vary according to the type of the circulatory degeneration, such as mitral insufficiency, stenosis, myocarditis, the position of thoracic or aortic aneurysm, or the condition of the vessel walls. The symptom complex known as angioneurotic edema may account for some forms of pulmonary disturbances.

The following cases are of interest on account of their pulmonary findings and symptoms:

1. Case no. 123893. Male. Single. Age thirty-nine. Printer by trade. Mother died at thirty-four with tuberculosis as the probable cause. Patient had a severe digestive disturbance at ten years of age, and at twelve suffered a slight attack of pleurisy. With these exceptions, his health has been good

until two years ago when a marked burning in the throat and stomach developed, giving a sensation as if acid had been swallowed. This symptom came on in attacks lasting for a few days at a time, and was frequently accompanied by rather profuse perspiration, especially at night, and shortness of breath associated with some cough and expectoration. These attacks have occurred at irregular intervals up to the present time. The patient complained of pains in the legs, especially the back of the thighs and, on examination, inspection showed a skin irritation resembling urticaria with slight edema. Careful inquiry elicited the fact that this cutaneous eruption and swelling appeared, at intervals, for the past two years, accompanying the other symptoms; and at one time during our observation a giant urticaria appeared on the right thigh.

Examination: Urine normal. Blood Wassermann negative. Complement fixation test for tuberculosis negative. Repeated sputum examinations negative. Intracutaneous tuberculin test negative.

Chest findings: X-ray stereos: Right lung: Peribronchial thickening and infiltration radiating to the apex from an enlarged hilum. No definite signs of parenchymatous changes. Left lung: Hilum is enlarged, and the descending bronchi are thickened. Physical findings: Slight systolic murmur at apex. Right lung: Decidedly roughened inspiration in the first and second interspace in front accompanied by fine moist râles, the latter increased over the hilum. Left lung shows roughened breath sounds below the clavicle.

The physical findings are of interest in that the moisture increased with the appearance of the cutaneous, respiratory, and gastric disturbances, and our conclusions were that the case was possibly one of angioneurotic edema with mild respiratory symptoms. We failed to find any sensitizing or other cause to account for this symptom complex.

This case was repeatedly diagnosed pulmonary tuberculosis and was treated for two years as such.

2. Case no. 102722. Male. Age thirty-nine. Married. This patient was sent West eleven years ago on account of pulmonary tuberculosis. The last three months he has had a return of pulmonary symptoms, such as cough and expectoration, fever, and loss of weight. Sputum contains tubercle bacilli. The shortness of breath seemed out of proportion to that found in cases of even extensive lung tuberculosis. The chest examination showed an enormously enlarged heart to be the chief cause of the dyspnea. The cardiodiaphragmatic angles were both obliterated suggesting pericardial effusion. Extensive signs of tuberculosis were also in evidence. At the left base, in the back, bronchial breath sounds could be heard which disappeared after 450 cc. of straw-colored fluid were aspirated from the pericardium, proving that compressed lung tissue accounted for the bronchial breathing.

This case is shown to point out an important pulmonary sign, which has been emphasized by Norris and Landis; that is, that in certain cases with an extremely enlarged heart or pericardial effusion, the lung is compressed at the left base, and bronchial breathing may be heard which, in turn, may be confused with pleural effusion or pneumonia.

3. Case no. 117355. Male. Age thirty-two. Married. Farmer. The patient comes to us complaining of shortness of breath on the slightest exertion. The pulse is 112; temperature 99.4; respiration 27 to 30 while sitting in chair. He has coughed for the past two months, and a few days ago a slight hemoptysis of 15 cc. occurred. The right lung showed dulness over the hilum which extended downwards and outwards towards the base. In the back the breath sounds were decidedly weakened over the lower half, with a dull percussion note. The left lung showed cogwheel breathing in the second interspace in front with roughened breath sounds in the back as low as the fifth rib. From this point to the base, some slight dulness was present on percussion.

In the physical examination, the interesting part is that there were no signs of moisture present although there was a decided change in the percussion note. There was a diffused apex beat with a systolic murmur extending into the axilla. The X-ray showed more abnormal pulmonary findings than the physical examination. In the right lung a dense, smoke-like shadow could be seen extending from the hilum downwards into the base. This shadow was irregular in outline and density, and thickened bronchi could be determined throughout it. The left lung showed the same irregular, cloudy shadow, involving the lung root and reaching the periphery between the second and fifth ribs in front. The heart was somewhat enlarged and had a configuration suggesting an aortic lesion. The blood Wassermann test gave a four plus reaction. Complement fixation for tuberculosis was negative.

Postmortem report of the lung tissue examined by Dr. Warthin showed a chronic passive congestion of the lung, very marked acute edema, and fresh hemorrhagic infarctions. The heart was somewhat enlarged and showed extensive endocarditis and myocarditis with hypertrophy.

This case is cited to show structural changes in the pulmonary tissue, the result of long standing chronic pulmonary congestion due to cardiac insufficiency.

4. Case no. 129907. Male. Age thirty-eight. Married. Patient was in good health until nine years ago when he developed a right frontal sinus infection which necessitated an external opening above the orbit and also drainage through the nasal cavity. In spite of these radical procedures, the sinus continued to discharge for six years until the right turbinates were

removed, together with an extensive submucous resection. Since the original infection, the patient has had a rather persistent bronchitis with mucopurulent expectoration free from tubercle bacilli. These symptoms were only partly relieved after the sinus discharge subsided.

A physical examination of the chest showed the presence of fine râles over the right hilum in front. The heart sounds were weak, the muscle tone poor, and no murmurs were heard. The blood pressure was systolic 120, diastolic 74. Chest stereo plates showed enlarged hilum shadows on both sides with a generalized peribronchial thickening throughout both lungs, more in evidence around the descending bronchi. Wassermann negative. Urine normal. No fever. Pulse, 78. Non-protein nitrogen test, 31.7. Blood sugar, 90. Alveolar CO_2 tension, 38. Basal metabolism, minus 9.

Digitalis was given in this case, and in a very short time the bronchial symptoms disappeared, and the general condition of the patient improved rapidly. This suggests that the bronchial symptoms were the result of two factors: first, the repeated descent of a chronic upper respiratory infection; and, second, myocardial degeneration.

5. *Case no. 128718.* Age thirty-one. This case has had repeated attacks of tonsillitis since boyhood. At eight years of age had a severe attack of typhoid fever. Three months ago had a slight hemoptysis. A few weeks ago he developed a cold followed by a persistent bronchitis associated with an unreasonable amount of dyspnea.

Examination: Cardiac dulness was increased to the left of the parasternal line 12 to 15 cm., and the right border extended 3 to 5 cm. in a corresponding direction. A systolic rumble was heard over the cardiac apex radiating to the left and followed by a presystolic sound taking the place of the rumble. The second pulmonic sound was greater than the second aortic. Blood pressure systolic 104, diastolic 70. Electrocardiographic tracings showed an unusually large split auricular wave suggestive of mitral stenosis. Moist râles at the base of each lung were in evidence, and scattered brhonchi could be found throughout the remainder of both lungs. The stereo plates showed a generalized peribronchial thickening throughout both lungs, enlarged hilum shadows, and the bronchial tree lost its distinct outline throughout the lower two-thirds of each lung. The heart was enlarged transversely, and the contour suggested the mitral type.

Digitalis was administered, and the respiratory symptoms and moisture disappeared in a few days. In this case, cardiac degeneration probably accounted for the delayed resolution of "the cold."

Dr. C. H. Vrooman, of Vancouver, Canada, reported to us the following interesting case.

6. The patient came to him suffering from some shortness of breath, cough, and streaked sputum. No fever. The pulse ran between 40 and 50, such as is found in partial heart block.

Physical examination: Showed a double mitral murmur at the apex, both systolic and regurgitant. Heart was enlarged transversely. There were no basal murmurs, but at the right apex as low as the second rib in front and the midscapular region in the back moist râles could be heard. Subcutaneous tuberculin test of 0.5 mgm. of O.T. caused a general reaction. The physical signs persisted for four years with associated cardiac symptoms.

A postmortem examination revealed an extensive brown induration of the right upper lobe due to chronic congestion. There was no sign of any tuberculosis in this lung. The only suspicion of the existence of pulmonary tuberculosis was the finding of a slight adhesion at the left apex. The heart showed an extensive generalized chronic endocarditis and a small button-hole mitral opening with extensive calcification.

CONCLUSIONS

1. All pulmonary signs and symptoms call for a careful study of the possible etiological factors.

2. Physical signs in the lung should not be the only basis in making the diagnosis.

3. Myocardial embarrassments of different types produce pulmonary signs and symptoms which are often misinterpreted.

4. In many cases of bronchitis, where doubt of the cause exists, the use of digitalis results in the diminution of symptoms and physical signs, thereby making this drug of value in diagnosis as well as a therapeutic agent.

5. In many cases with bronchial symptoms, such as are present in protracted colds, circulatory degeneration should be considered as a possible causative factor as well as upper respiratory affections and pulmonary tuberculosis.

6. Râles due to circulatory causes are not always basal and may be found over other parts, even one or both apices.

THE INTERNATIONAL ASSOCIATION OF ARTIFICIAL PNEUMOTHORAX

Dr. S. Adolphus Knopf of New York transmits the following announcement which was sent to him by Professor Carpi as a circular letter in French, with the request that he translate it and cause it to be published in various American periodicals:

INTERNATIONAL ASSOCIATION OF "PNEUMOTHORAX ARTIFICIALIS"

Lugano, Switzerland, August, 1920.

The International Association of "Pneumothorax Artificialis," the work of which was discontinued during the long war, desires to resume its activity by inviting all former members of the Association to renew their subscription and all other physicians interested in artificial pneumothorax to send their names and addresses to Prof. Umberto Carpi, Lugano, Switzerland, and to become members.

The purpose of the Association is to spread all practical and scientific information concerning artificial pneumothorax. Although induced pneumothorax for therapeutic purposes has become remarkably prevalent ("*Bien que la diffusion de la thérapie du pneumothorax soit devenue très remarquable*"), it has remained a therapeutic procedure applied only by physicians specially trained and experienced in this operation. For the convenience of the patients who may be obliged to change their residences, to know the names and addresses of physicians who practise artificial pneumothorax is of great value, in order that the patient may continue the treatment by periodic refilling. A complete list of physicians practising artificial pneumothorax will be published with the scientific journal known as *Pneumothorax Thérapeutique* for 1920–1921, edited by Carlo Forlanini. This list will be sent to all the members and to the most important medical societies, medical academies, and similar institutions of the different countries. In the journal will be enumerated and discussed all the world's literature on pneumothorax. The association will continue its labors under the policy indicated by the illustrious master and creator of artificial pneumothorax therapy.

As soon as the finances of the society will permit the renewal of the publication, the editor will put himself in communication with the editors of such medical journals of other countries as are publishing articles on artificial pneumothorax. For the present these are *Die Sonderhefte des Tuberkulose Centralblattes über Lungenkollapstherapie* and the collected monographs in the journal *La Tuberculosi* which appears in Rome.

Subscriptions should be addressed to the General Secretary, Prof. U. Carpi, Lugano. The subscriber is entitled to receive the journal with the list of names. Those who desire to receive the monographs of the journals indicated should make a request for them to the General Secretary who also has an international exchange office for all publications appertaining to artificial pneumothorax. Summaries in English, French, and German on any topic relating to artificial pneumothorax will be gratefully received and published.

PROF. U. CARPI,
General Secretary, Lugano, Switzerland.

FIRST INFECTION WITH TUBERCULOSIS BY WAY OF THE LUNGS

EUGENE L. OPIE AND HANS ANDERSEN

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A study of the lesions of first infection with tuberculosis was published by one of the authors several years ago with the purpose of defining the characters of these lesions as well as their frequency in this country (1). Occurring in those who have died from all causes, they are usually healed and in great part calcified, so that they are readily demonstrated by X-ray plates made from the lungs after death.

The lesions which occur in the lungs of almost all individuals who die from conditions other than tuberculosis have the characters of the tuberculosis of childhood, that is, they occur as foci in the substance of the lung and are not more frequent in the apices than elsewhere. They are accompanied by more extensive lesions in the adjacent lymphatic nodes. The occurrence of these focal lesions, which are almost constantly found, does not exclude the more familiar type of tuberculosis, namely, the apical lesion. In association with the apical lesions, which occur in the later period of childhood and in adult life, there is no caseation nor calcification of the regional lymph nodes. In harmony with experimental observations, the early focal lesion has the character of a first infection and implicates the lymphatic nodes; whereas the apical lesion has the character of a second infection and exhibits no tendency to cause caseous tuberculosis of adjacent lymph nodes. It was shown that apical lesions increase in frequency with increasing age. They rarely occurred before ten years of age; from ten to eighteen the incidence was 11 per cent; between eighteen and fifty years of age the incidence of apical lesions in those who had died with conditions other than tuberculosis was approximately 14 per cent; and after the age of fifty the incidence of apical lesions was much increased, for they were present in more than one-third of those who had died from all causes.

An accurate interpretation of the pathology of tuberculosis of the lungs is dependent upon a recognition of the distinction between (1) focal tuberculosis which usually has its origin in childhood and (2) apical tuberculosis which appears in the later period of childhood and in adult life.

The size and distribution of calcified focal lesions of the lungs and corresponding lesions of adjacent lymphatic nodes are well defined in X-ray plates made from the lungs after they have been removed from the body. In order to designate the severity of preëxisting tuberculous infection it has been convenient to separate the lesions into groups corresponding with the magnitude and extent of the calcified nodules. This has seemed desirable in order to determine how frequently healed pulmonary lesions are as extensive as those active lesions which cause death with generalized tuberculosis. In many instances the X-ray plate demonstrates that the individual has suffered with tuberculosis which would have been recognizable at some time during life had suitable diagnostic measures been employed. In some of these individuals there has been evidence of dissemination of the infection outside of the lungs and its lymph nodes, for in association with extensive lesions of the lungs healed tubercles have been found in spleen, liver or other organs.

The following grouping is convenient though arbitrary, because it serves to indicate within wide limits the severity of the preëxisting pulmonary infection:

Group 1. In many lungs there are one or several small nodules within the pulmonary tissue, and one or several calcified nodules will be seen in the X-ray plate at the hilum of the lung and localized by dissection within lymphatic nodes adjacent to the pulmonary focus of calcification (plate 1, fig. 1). The largest of the lesions placed in this group seldom exceed 0.5 cm.

Group 2. In nearly half of all the lungs examined the lesions shown by X-ray plates are somewhat more extensive (plate 1, fig. 2). There are widely scattered nodules or occasionally a single nodule (0.5 to 1 cm.) within the lung and larger calcified masses from 1 to 2 cm. in adjacent lymphatic nodes.

Group 3. In a considerable number of instances there are multiple scattered nodules within the lung associated with massive calcified tuberculosis of lymphatic nodes at the hilum of one or both lungs, outside of the lungs in proximity to one or other bronchus, at the bifurcation of the trachea or on one side, usually on the right, of the trachea (plate 2, fig. 3).

Group 4. In a few instances there is more widespread calcified tuberculosis. The lungs are thickly and often almost uniformly studded with nodules, often 0.5 cm. in diameter (plate 2, fig. 4, and the following figures). These nodules are represented by conspicuous spots in the X-ray plate; but on superficial examination of the lungs themselves their great abundance might be overlooked, for only an occasional calcified nodule may be seen upon the cut section or below the pleural surface. There may be extensive lesions at the hilum of the lung or about the trachea similar to those found with the preceding group.

An examination of X-ray plates from 86 lungs from adults dying from all causes, taken at a time when these X-ray plates were made from almost every autopsy, showed that the grouping, in accordance with the artificial plan described above, was as follows:

TABLE 1

	Autopsies
No calcified lesion shown by X-ray plate	7
Group 1	28
2	41
3	7
4	3
Total	86

It is noteworthy that the absence of calcified lesions does not exclude the occurrence of tuberculosis. This subject has been discussed in a former article (*loc. cit.*).

The cases in which healed tuberculosis has been so extensive that the lesion has been placed in groups 3 and 4 described above will be reviewed in brief detail. A large part of these cases are not included in the tabulation just given because they were encountered at a time when the routine preparation of X-ray plates had been discontinued. These lesions are described because they give evidence that the individual has passed through a grave infection which, even though its symptoms were so inconspicuous that they left little, if any, impression upon his memory, nevertheless subjected him to grave danger at some period of his childhood. Many of those who discuss the symptomatology of tuberculosis appear to believe that the focal and apical tuberculous lesions which are present in a large proportion of all human beings are of interest only to the pathologist. The following instances of healed tuberculosis emphasize the futility of attempting to draw a line between clinical tuberculosis and tuberculosis which fails to impress the patient or the physician.

In the seven cases which follow there has been extensive focal tuberculosis of the lungs which has healed with calcification and similar more extensive lesions of the regional lymphatic nodes. The extent of the lesions in these cases have placed them in group 3; and at the same time there has been a dissemination of tuberculosis to distant organs, as shown by the presence of healed calcified and encapsulated nodules in the liver and spleen. The occurrence of these nodules in association with extensive healed tuberculosis of the lung and pulmonary lymph nodes furnishes convincing evidence of their tuberculous origin.

Autopsy 759. *Calcified and caseous focal tuberculosis of lungs; encapsulated caseous tuberculosis of lymphatic nodes; fibroid and calcified apical tuberculosis; healed tubercles of spleen and liver.* A man, aged seventy-four years, died with purulent peritonitis following resection of the caecum for carcinoma. There is a calcified nodule, 12 mm. across, below the pleura of the right middle lobe, with small nodules clustered about it. There is a partly calcified caseous nodule in each lower lobe. Lymphatic nodes, containing encapsulated caseous foci, occur at the hilum of each lung. At the apex of the right lung is an area of fibrous induration forming an area beneath the pleura, 1.5 cm. in thickness, containing small cavities with smooth walls. There is no caseation, but at one point within the fibrous tissue is a calcified focus. Similar fibrous induration occurs at the apex of the left lung. The spleen contains spherical nodules with fibrous capsule and calcified centres, varying in diameter from 1 to 2 mm., and two larger nodules with firmly calcified centres are 3.5 mm. in diameter. The liver contains similar calcified nodules.

Autopsy 796. *Calcified focal tuberculosis of lungs and extensive calcified tuberculosis of pulmonary and bronchial lymphatic nodes; healed tubercles of spleen and liver.* A woman, aged thirty-seven years, died as the result of inflammation about a gauze sponge left within the pelvis at operation performed several years before death. In the lungs (plate 2, fig. 3) are scattered calcified nodules, the largest of which in the left lower lobe is 1 cm. across. At the hilum of the left lung is a large mass of calcified nodules, measuring 2.8 x 1.3 cm., and above the left bronchus and below the bifurcation of the trachea are partly calcified lymph nodes. In the mediastinum near the median margin of the left lower lobe is a calcified lymph node measuring 1.3 x 0.7 cm. The spleen and liver (plate 2, fig. 3) contain numerous round fibrous nodules, about 1 mm. in diameter resembling healed tubercles.

Autopsy 824. *Multiple calcified, partly caseous foci of tuberculosis in lungs; extensive caseous calcified tuberculosis of lymph nodes of lungs and bronchi; calcified caseous tubercles in spleen and liver.* A white woman, aged fifty-one years, died with fibrinopurulent peritonitis following the rupture of an ovarian

cyst. Scattered in both lungs are nodules containing mortar-like material which is dry, caseous, and partly calcified. At the hilum of the right lung are partly calcified lymph nodes, 1.5 cm. across, and at the bifurcation of the trachea is a partly calcified lymph node, 3.3 x 2 cm. The spleen contains several yellowish white nodules from 3 to 5 mm. in diameter, which are partly calcified and have in some instances caseous centres. Several similar nodules of somewhat smaller size occur in the liver.

Autopsy 942. *Multiple calcified tuberculous foci in lungs; extensive caseous calcified tuberculosis of pulmonary and bronchial lymph nodes; healed tubercles of spleen and liver.* A white man, aged nineteen years. His father died with tuberculosis at the age of forty-four years; his mother is ill at present and tuberculosis is suspected. Death occurred with purpura hemorrhagica and anemia. Five calcified nodules, from 2 to 4 mm. across, occur in the upper lobe of the right lung. Calcified areas occur in the lymph nodes at the hilum of the right lung, and to the right of the trachea near its bifurcation is a large lymph node, 4 x 1.9 cm., in large part replaced by caseous and calcified material. A small calcified focus occurs in the left lung. Caseous and calcified encapsulated nodules occur in the spleen and spherical encapsulated bodies in the liver.

Autopsy 1000. *Multiple calcified foci of healed tuberculosis in lungs; extensive calcified tuberculosis of pulmonary and bronchial lymph nodes; healed tubercles in liver.* A woman, aged fifty-two years, died from pernicious anemia. In the upper lobe of the right lung is a firmly calcified nodule, 7 mm. in diameter; elsewhere in the lung are round calcified nodules from 1 to 2.5 cm. across. Near the hilum of the right lung is a chain of large calcified masses from 0.7 to 1.5 cm. across. Below the right bronchus is a larger calcified lymph node, 2.3 by 1.5 cm., and to the right of the trachea another of about the same size. In the left lung are several calcified nodules. Below the surface of the liver are several firm gray fibrous nodules about 1 mm. in diameter.

Autopsy 1015. *Multiple foci of calcified tuberculosis occurring in groups in both lungs; extensive calcified tuberculosis of adjacent lymph nodes; multiple fibrous and calcified tubercles of spleen.* A white man, aged thirty-six years, died with syphilitic aortitis, cardiac thrombosis and multiple infarcts. In the lower lobe of the right lung is a calcified nodule, 0.5 cm. in diameter, and below it a group of smaller calcified nodules in an area, 3.5 x 2 cm. In an almost straight line, with the long axis of this group and distributed below the right bronchus, is a chain of calcified masses, the largest of which measures 3.8 x 1 cm. In the lower half of the left lung are 3 conspicuous calcified nodules, the largest of which is 1.4 x 0.8 cm. Smaller calcified nodules occur elsewhere in the left lung. Throughout the spleen are small, hard, spherical, fibrous nodules, about 1 mm. in diameter and larger yellow calcified nodules.

Autopsy 1016. *Multiple calcified foci of tuberculosis in both lungs; extensive calcified tuberculosis of adjacent lymph nodes; calcified tuberculosis of mesenteric and hepatic lymph nodes; fibrous nodules in liver.* A white man, aged fifty-six years, died with chronic ulcerative colitis. In the peripheral part of the left lung is a densely calcified nodule, 1.1 x 0.9 cm. In a straight line with this nodule is a chain of calcified nodules, forming an irregular group, 3 x 1 cm., distributed below the bronchus to the right lower lobe. Below the right bronchus near the bifurcation of the trachea is a very densely calcified mass, 2.5 x 1.7 cm. In the right and left lungs are several scattered nodules, about 2 mm. in diameter. In the mesentery are two large round calcified nodules, 7 mm. in diameter, situated close together. The X-ray plate shows that calcification within these bodies has a lamellated distribution. Elsewhere scattered in the mesentery are round calcified nodules, from 1 to 3 mm. in diameter, and similarly lamellated. In contact with the liver is an irregularly calcified lymph node, 1.3 x 1.1 cm. Below the capsule of the lung are gray nodules, 1 or 2 mm. in diameter.

It is noteworthy that in autopsy 1016 calcified mesenteric tuberculosis together with a similar lesion of a lymph node near the liver has accompanied very extensive tuberculosis of the lung and its lymph nodes. In this instance it is impossible to determine whether tuberculosis of abdominal lymph nodes had its origin in the intestine or was carried from the lungs to these tissues by the blood stream. Tubercles present in this instance in the liver and spleen were hematogenous.

Among the cases in which the lesion has been so extensive that it has been placed in group 3 healed tubercles of the spleen or liver have been absent in only two, which follow.

Autopsy 999. *Calcified focal tuberculosis in right lung; healed calcified tubercles resembling miliary tubercles in the same lung; tuberculosis of pulmonary lymph nodes.* A white man, aged twenty-one years, died as the result of endocarditis caused by Streptococcus viridans. In the lower lobe of the right lung is a calcified nodule, 7 mm. in diameter. At the hilum of the right lung and below the right bronchus, within the lymph nodes, are nodules of calcification, from 0.5 to 1 cm. across. Throughout both lungs are numerous round nodules, 1 mm. in diameter, evenly distributed and resembling miliary tubercles.

Autopsy 1027. *Pulmonary foci of calcified tuberculosis; extensive calcified tuberculosis of lymph nodes at hilum of right lung; double fibrous and calcified apical tuberculosis.* A white man, aged thirty-eight years, died with multiple sclerosis and pyelonephritis. One brother died of pulmonary tuberculosis at the age of twenty-five years, but it is stated that he became sick while away

from home and was cared for until his death in a hospital. Scattered in both lungs are small calcified and fibrous nodules. Near the hilum of the right lung, within lymph nodes, are a large number of densely calcified masses, from 0.5 to 1 cm. across. Both apices are puckered; and contain fibrous scars in which are calcified nodules, from 1 to 2.5 mm. across.

Among the nine foregoing instances of extensive focal tuberculosis of the lungs there has been associated healed apical tuberculosis in two, namely, in autopsies 759 and 1027, aged seventy-four and thirty-eight years, respectively.

The cases which will be described later are grouped together because the lungs were the site of very advanced tuberculosis which had healed (group 4 above). It is evident from the examination of the lungs, as indicated best by the X-ray plates, that at some time preceding death the individual has suffered with a severe widespread tuberculosis of the lungs, which has not caused death but has persisted so long that caseous material has been completely replaced by calcium deposit. It may be assumed that the lesion is healed, since all evidence of activity has disappeared.

Autopsies 783, 1405 and 838 demonstrate that these extensive lesions may produce secondary tubercles in the liver and spleen and even in other organs; yet these secondary lesions like those in the lung may undergo encapsulation and calcification.

AUTOPSY 783. *Numerous calcified and encapsulated healed tubercles in the lungs; extensive tuberculosis of the pulmonary and tracheal lymph nodes; healed tubercles in liver and spleen.* A woman, aged thirty-six years, died with general infection by Staphylococcus pyogenes aureus, following panhysterectomy for myomata. Large round firmly calcified nodules occur scattered throughout both lungs (plate 2, fig. 4). In each lung there are approximately 15 nodules, measuring from 2.5 to 5 mm., and smaller nodules in large number. In the X-ray plate many of the large nodules have a well defined partly calcified capsule, which is in sharp contrast with the more opaque firmly calcified centre. At the hilum of each lung are several calcified lymphatic nodes, the largest of which, situated in the right lung, contains a calcified mass, 1.5 x 1 cm.; and below the bifurcation of the trachea to the right of the midline is a large calcified mass 3 x 2 cm. In the spleen (plate 2, fig. 4) there is a round firm yellowish white nodule, 1.5 mm. in diameter, situated below the capsule. Similar round and at times distinctly encapsulated bodies occur in the liver.

AUTOPSY 1405. *Multiple large calcified foci of healed tuberculosis throughout both lungs; healed calcified tuberculosis of adjacent lymph nodes; healed tuber-*

culosis of spleen. A white man, aged forty-six years, died with generalized carcinoma, primary in the left kidney. The lungs (plate 3, fig. 5) contain numerous metastases of carcinoma which are well defined in the X-ray plate. In each lung there are about 20 firmly calcified nodules from 3 to 5 mm. in diameter. One nodule near the periphery of the lung is 9 mm. across. At the hilum of each lung are irregular calcified lymph nodes, the largest of which is 1 x 2 cm. The spleen contains numerous firm white nodules which are 1 mm. or more in diameter.

In the following instance tuberculosis of the lung and of the adjacent lymphatic nodes was more extensive than in any other case which has been observed by us. In addition to calcified and encapsulated nodules in the liver and spleen which resembled the tubercles found in all of the foregoing cases there were similar calcified nodules in the pia mater over the cerebrum.

Autopsy 838. *Large calcified healed tubercles throughout both lungs; very extensive calcified and healed tuberculosis of pulmonary, peribronchial, peritracheal and posterior mediastinal lymph nodes; calcified nodules (healed tubercles) in liver, spleen, and pia mater.* A white man, aged twenty-six years. The patient had had whooping cough at eleven years of age, pneumonia at sixteen, and gonorrhea at seventeen. He used alcohol in excess at intervals. His fatal illness began ten months before his death, when several sores appeared upon the foreskin. These remained long unhealed. A skin eruption followed and the patient was treated for syphilis at Hot Springs, Arkansas, and elsewhere. Two months before death there were severe headache, weakness and numbness of the legs and difficulty in urination. Speech was slow and there was difficulty in swallowing. Vomiting occurred occasionally soon after meals. There had been double vision and pain in the eyes for about one month. The Wassermann reaction was positive with the blood serum and with the spinal fluid. Circumcision was performed. From June 1 to 4, from 10 to 15 minims of 1 per cent solution of bichloride of mercury were given daily by intramuscular injection. On June 6, 0.6 gram of salvarsan was administered. On June 7, 10 minims of 1 per cent solution of bichloride were injected into the muscle. On June 8 the patient was resting quietly at 8 p.m. At 1 a.m. he was perspiring, there was tremor and the eyes were widely opened, and brownish stringy saliva which later became watery exuded from the mouth.

Almost uniformily scattered throughout each lung (plate 3, fig. 6) are from 20 to 25 nodules, from 3 to 6 mm. in diameter, together with some smaller nodules. Larger, irregularly calcified masses, from 1 to 0.5 cm., occur at the hilum of each lung. Below the right bronchus is a similar mass of very large

size, measuring 4.2 x 2 cm., and to the right of the trachea is an almost homogeneously calcified mass, 4.3 x 2.8 cm. In the posterior mediastinum, near the diaphragm, is a homogeneously calcified body (doubtless a lymph node), 2 x 1.3 cm. Scattered below the capsule of the liver and in the spleen are small round nodules, having the character of healed tubercles. Upon the pia mater of the right frontal lobe are several calcified yellowish white nodules, 1 to 2 mm. in diameter, which have the appearance of the calcified tubercles seen in other organs.

The patient had suffered with syphilis, acquired ten months before his death. On the one hand there is no evidence that syphilis of the meninges can produce calcified nodules of the pia mater, and the firm calcification of these nodules indicates that they bear no relation to syphilis which was of recent origin. On the other hand they are associated with advanced healed tuberculosis of the lungs and its lymphatic system and occur in association with identical lesions of the liver and spleen. The lesions of the pia mater may be regarded as evidence of tuberculous meningitis which has healed.

In the two instances which follow there has been extensive healed pulmonary tuberculosis with no apparent dissemination of the lesion.

AUTOPSY 862. *Multiple firmly calcified and encapsulated foci of healed pulmonary tuberculosis; calcified healed tuberculosis of the pulmonary and peribronchial lymph nodes; fibrous, caseous and calcified tuberculosis of the apices of both lungs.* A white woman, aged seventy-three years, died with general arteriosclerosis and chronic diffuse nephritis with small granular kidneys. The pleura at the apex of the right lung (plate 4, fig. 7) is puckered and there are several fibrous scars, within which occur caseous and calcified nodules, the largest of which is 8 mm. in diameter. At the left apex there is a fibrous scar containing calcified areas. Firmly calcified nodules, about 4 mm. in diameter, are numerous throughout both lungs, and smaller nodules, 1 or 2 mm. in diameter, are found. The larger bodies have a double contour as if surrounded by a capsule. At the hilum of each lung there are calcified masses forming irregularly disposed groups within the lymphatic nodes.

AUTOPSY 1235. *Numerous foci of calcified tuberculosis scattered throughout the lungs; extensive calcified tuberculosis of adjacent lymph nodes; healed tuberculosis of apex of left lung.* A white man, aged fifty-one years. At the age of sixteen the patient had some fever with night sweats and chills but had subsequently been well. Death occurred with syphilitic aortitis, aneurysm of the aorta and aortic endocarditis. A Wassermann reaction was present during life. In each lung are about 15 calcified and encapsulated nodules,

from 3 to 4 mm. in diameter, and about 8 of smaller size. At the hilum of each lung are large lymph nodes, the largest 2.2 cm. in length and containing encapsulated calcified nodules. A large calcified mass, 2.5 x 1.5 cm., is found below the bifurcation of the trachea. A conspicuous calcified mass occurs at the right of the trachea and there is another in the posterior mediastinum. At the left apex which is much puckered is a fibrous scar containing small calcified nodules.

Among five instances of very extensive healed focal tuberculosis of the lung apical tuberculosis was found in two instances, namely, in autopsies 862 and 1235. The ages of the individuals affected were seventy-three and fifty-one years. One of the authors has pointed out in a previous communication (*loc. cit.*) that healed apical tuberculosis is found with greatest frequency in those who have died at an advanced age.

The following instance of extensive healed pulmonary tuberculosis is noteworthy because it occurred in a boy fourteen years of age who died a few days after the onset of an acute disease.

AUTOPSY 1293. *Disseminated calcified tuberculous foci in lungs and calcified tuberculosis of pulmonary lymph nodes.* A white boy, aged fourteen years. Following an illness of six days the patient died with general purulent peritonitis, following the rupture of a gangrenous appendix. The lungs (plate 4, fig. 8) which contain a moderate amount of coal pigment are thickly studded with numerous calcified yellow nodules, situated below the pleura and within the lung substance. These nodules show considerable uniformity in size, varying in diameter from 1 mm. or less to 3 mm. At the hilum of each lung lymphatic nodes contain somewhat larger and more irregularly shaped calcified nodules. In the liver, spleen and kidneys there are no fibrous or calcified nodules.

Study of these lesions of first infection with tuberculosis has been much neglected, but is essential to an understanding of the mode of tuberculous infection and the conditions under which it occurs. The size and extent of the lesions which have been described demonstrate that they are not without clinical significance and have probably been accompanied by symptoms such as pyrexia and diminution of body weight.

With few exceptions an X-ray plate made from the lung of an adult demonstrates the presence of conspicuous calcified nodules in the lung

and in adjacent lymph nodes, whereas in approximately half of all adults the healed pulmonary nodules, which are usually multiple, are from 0.5 to 1 cm. in diameter, and the more numerous nodules of the lymph nodes are from 1 to 2 cm. across (group 2). It is probable that these lesions were considerably larger and more numerous in their active stage, for tuberculous lesions tend to resolve when recovery occurs and persist as calcified masses only when caseation has been present. In more than one in every ten individuals the calcified lesions present in the lung at autopsy show that the individual has suffered with widely disseminated tuberculosis of the lung and massive tuberculosis of the adjacent lymph nodes (groups 3 and 4). Evidence of extension of the tuberculous infection to distant organs is not uncommon and healed tubercles in the liver or spleen, usually in both, have been found in 10 of 14 instances of extensive healed tuberculosis of the lungs (groups 3 and 4).

In one instance, in association with healed tuberculosis of the lungs and adjacent lymph nodes, more advanced than in any other instances and with healed tubercles of the liver and spleen, similar calcified nodules have been found in the pia mater. Tuberculous meningitis has been followed by recovery, with calcification of those meningeal tubercles which have undergone caseation.

No line can be drawn between the lesions which have been described and those which produce obvious symptoms and death. The distinction between latent and clinical tuberculosis, which is not infrequently made, has no other basis than the limitations of diagnostic methods and the tendency of tuberculosis to proceed to recovery.

REFERENCE

(1) Opie, E. L.: Jour. Exp. Med., 1917, xxv, 855, and xxvi, 263.

Plate 1

Fig. 1. X-ray plate from autopsy 710 illustrating the extent of calcified focal tuberculosis represented by group 1.

Fig. 2. X-ray plate from autopsy 821 illustrating the extent of calcified focal tuberculosis represented by group 2.

140

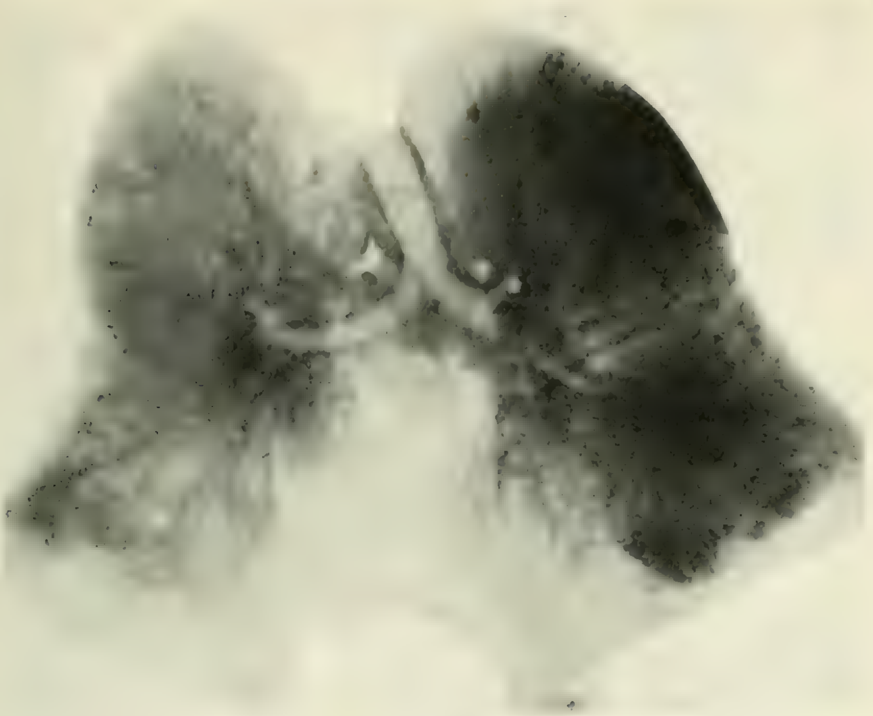

Fig. 1

Fig. 2

PLATE 2

FIG. 3. X-ray plate from autopsy 796 illustrating the extent of calcified focal tuberculosis represented by group 3. The spleen containing several calcified nodules is shown at the upper right hand corner.

FIG. 4. X-ray plate from autopsy 783 showing disseminated calcified focal tuberculosis of the lungs and massive calcified tuberculosis of lymph nodes (group 4). The spleen containing several calcified nodules is shown at the upper right hand corner.

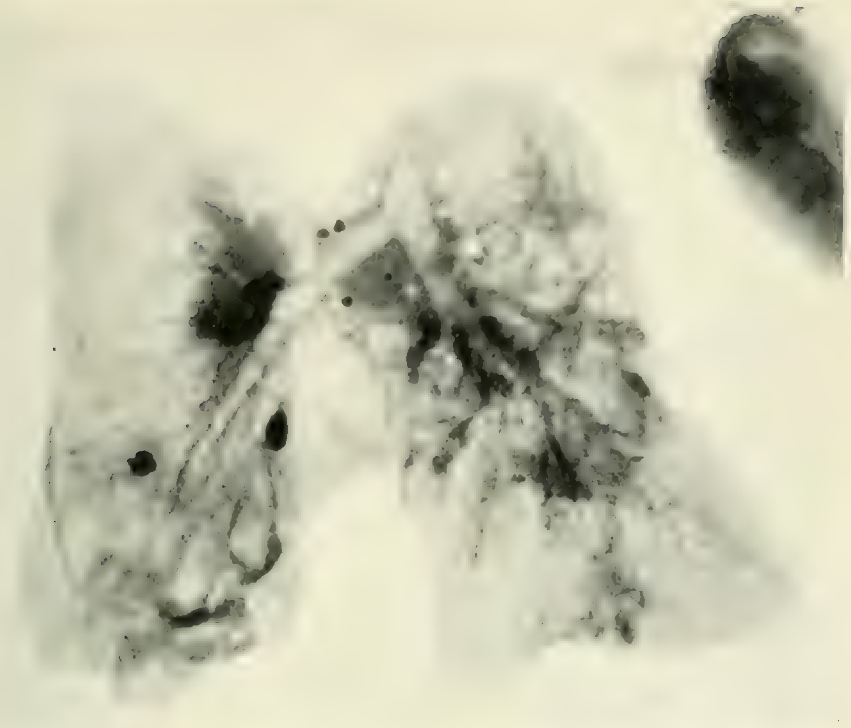

FIG. 3

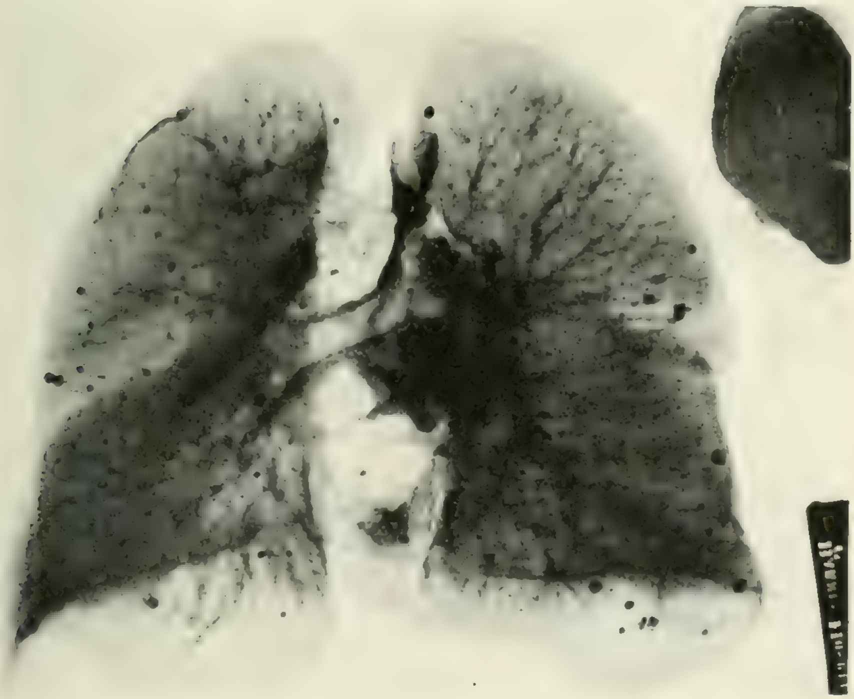

FIG. 4

PLATE 3

FIG. 5. X-ray plate from autopsy 1405 showing disseminated calcified focal tuberculosis of lungs and adjacent lymph nodes (group 4). Shadows caused by metastases of carcinoma are well defined.

FIG. 6. X-ray plate from autopsy 838 showing very extensive calcified focal tuberculosis of lungs and lymph nodes (group 4).

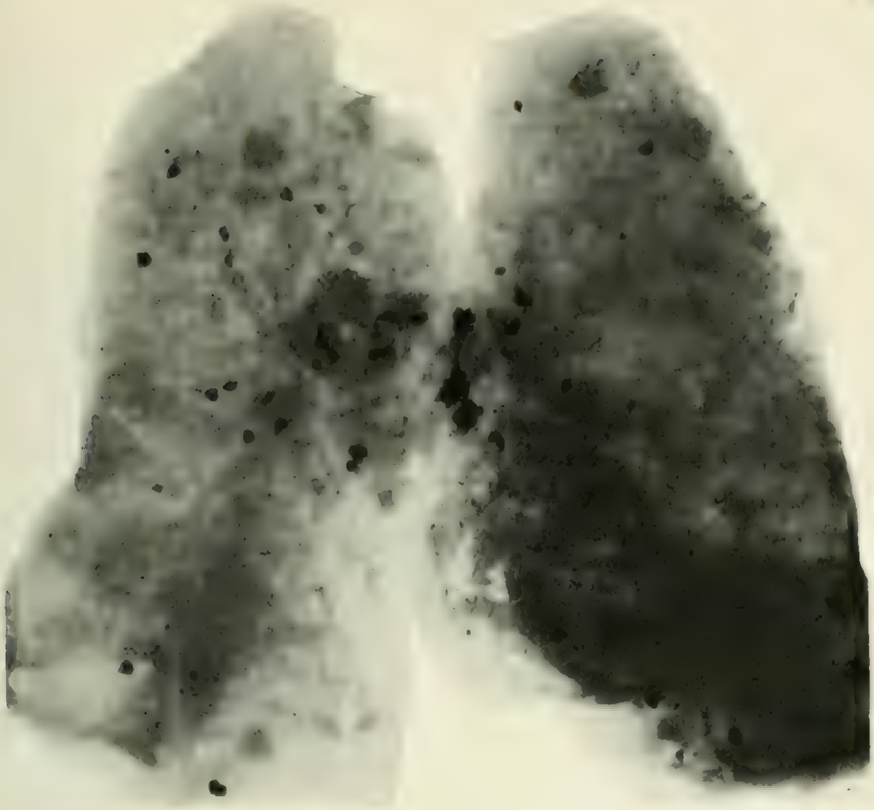

Fig. 5

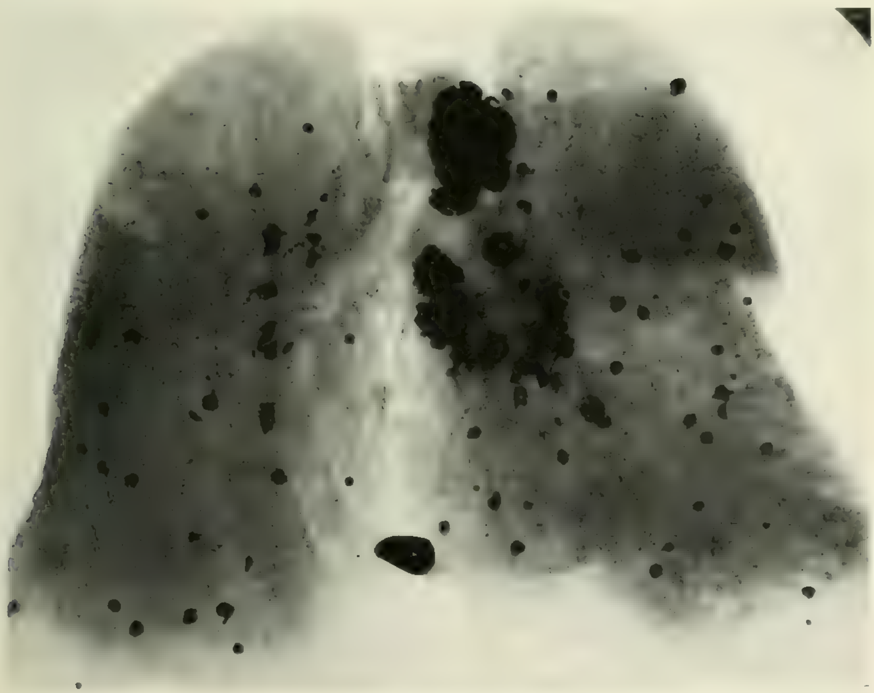

Fig. 6

PLATE 4

FIG. 7. X-ray plate from autopsy 862 showing extensive calcified focal and apical tuberculosis of the lungs (group 4).

FIG. 8. X-ray plate from a child aged fourteen years (autopsy 1293) showing disseminated calcified focal tuberculosis of the lungs (group 4).

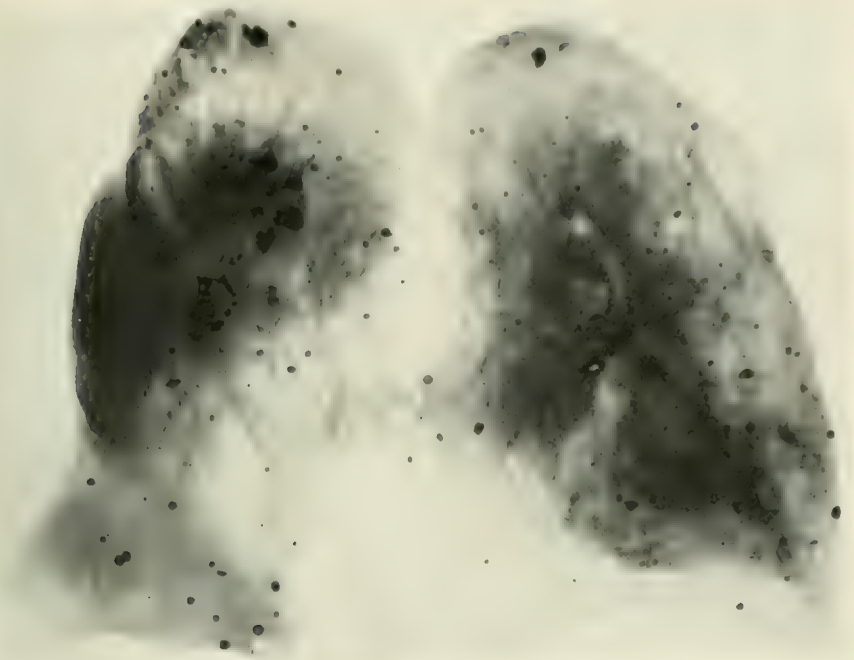

FIG. 7

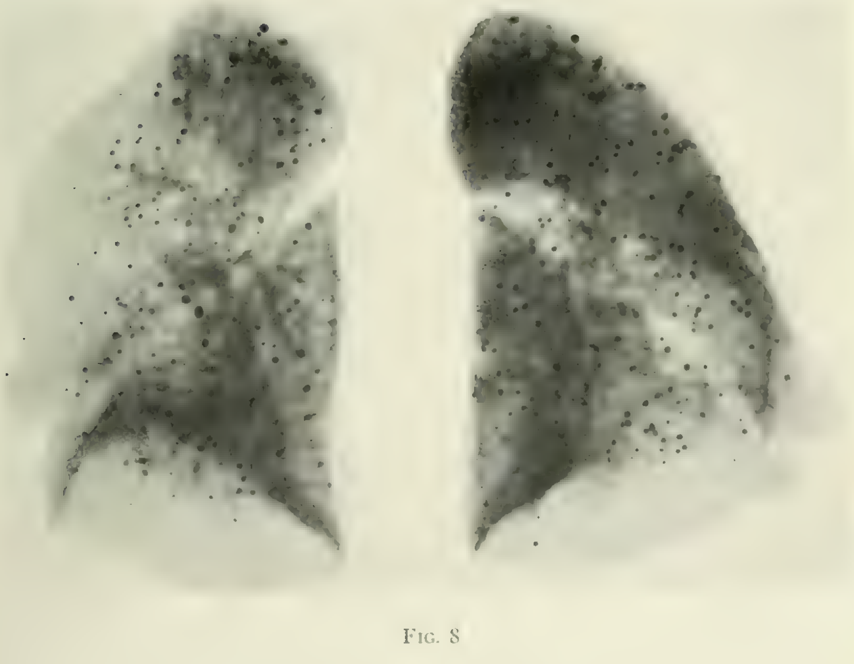

FIG. 8

FIRST INFECTION WITH TUBERCULOSIS BY WAY OF THE INTESTINAL TRACT

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The following observations are recorded in order to explain the significance of tuberculous infection which occurs in childhood and at times in adult life and is recognizable subsequently as encapsulated and calcified foci of healed or healing tuberculosis.

Few instances of healed tuberculosis of the mesenteric lymph nodes are found among children or adults examined in the city of St. Louis. In a series of 93 autopsies made in 1917 upon children and of 50 autopsies made on adults no instance of healed mesenteric tuberculosis was found. Nevertheless it is probable that primary tuberculosis of the gastro-intestinal tract occurs in a small proportion of children in St. Louis as elsewhere. An impressive contrast has been furnished by autopsies performed on British soldiers made at Base Hospital 21 stationed at Rouen, France, for they have demonstrated the surprising frequency of healed calcified, occasionally still partially caseous or even frankly caseous, lesions of the mesenteric lymph nodes. Healed focal and lymphatic tuberculosis of the lungs similar to that seen in St. Louis was common (plate 1, fig. 1) and often the lesions were very extensive; but instances in which little if any old pulmonary tuberculosis was demonstrable appeared to be much more common among the British than in St. Louis where the former observations had been made. It is not improbable that the lower incidence of the lesions of the lungs bears some relation to the greater frequency of localized infection by way of the intestinal tract.

Caseous or calcified mesenteric nodules were found in 18 instances among 66 young male adults whose age with few exceptions varied from twenty to thirty years. Among 15 autopsies of which notes were lost the proportion of mesenteric tuberculosis was approximately the same. In a number of instances X-ray plates were made from both the mesentery and the lungs; and they serve to show with considerable accuracy the size and position of the calcified lesions which were present.

Since the lesions under consideration have their origin in childhood they rarely exhibit fresh caseation. In one instance there was active caseous tuberculosis of a mesenteric lymph node. Beginning calcification was not evident when the node was sectioned, but an X-ray plate of the freshly removed mesentery shows a characteristic shadow of calcification which occupies a narrow zone at the edge of the caseous area.

AUTOPSY 43. *Caseous tuberculosis of mesenteric lymph node with beginning calcification; the lungs show no evidence of tuberculosis.* Age was twenty-two years. Death occurred as the result of lacerated wounds of both thighs with suppuration and gas gangrene. The lungs (plate 1, fig. 2) sectioned to 3 mm. after hardening in formalin exhibit no evidence of tuberculosis. In the mesentery (plate 1, fig. 2) near the intestine is a firm lymph node 8 by 5 mm. which has a caseous centre and a gray peripheral zone about 1 mm. in thickness. The X-ray plate shows beginning calcification.

In three instances the tuberculous lesion was still obviously caseous though it was encapsulated and doubtless localized. Calcification was so advanced that it had given the caseous material a mortar-like consistency.

AUTOPSY 65. *Caseous and calcified tuberculosis of mesenteric lymph nodes; no tuberculosis of lungs was found.* Age was twenty-one years. Death occurred with suppurative bronchopneumonia following mustard gas poisoning. The lungs and lymph nodes of the neck were examined at the time of autopsy but no evidence of fresh or old tuberculosis was found. In the mesentery was a lymph node in large part replaced by caseous material which was surrounded by a fibrous capsule. In another node was a caseous and partly calcified area 3 mm. across.

AUTOPSY 75. *Calcified and caseous tuberculosis of mesenteric lymph nodes; no tuberculosis of lungs was found.* Age was twenty-seven years. Death occurred from a penetrating wound of the thigh followed by suppurative thrombophlebitis with infected infarcts of the lungs. The lungs and lymph nodes of the neck examined at autopsy exhibited no evidence of tuberculosis. At the base of the mesentery were two partially calcified caseous masses, 1.8 and 1.5 cm. across. The caseous material was dry and mortar-like, contained firmly calcified particles and was surrounded by a fibrous capsule. A lymph node containing smaller nodules of similar character occurred nearby.

AUTOPSY 80. *Calcified and caseous tuberculosis of mesenteric lymph nodes; no tuberculosis was found in the lungs.* Age was twenty years. There were wounds of the left leg with compound fracture of the tibia and fibula, amputation through the right thigh and contusion of the liver. No tuberculosis

of the lungs nor of adjacent lymph nodes was found at autopsy. Numerous lymph nodes in the mesentery measuring less than 1 cm. in their long diameter were caseous and partly calcified. In the mesentery of the ileum was a chain of six nodes, each from 0.7 to 1 cm. across, containing firmly calcified nodules with diameter from 3 to 4 mm.

With focal tuberculosis of the lungs it is not uncommon to find lesions in the same lung showing differences in the degree of calcification which suggest differences in the age of the selesions. At autopsy 80 some lesions of the mesentery were caseous and calcified, whereas others were completely healed and firmly calcified.

In thirteen instances the mesenteric lymph nodes contained completely healed firmly calcified tuberculous lesions.

AUTOPSY 13. *Calcified lymph nodes in mesentery of ileum; calcified nodule (perhaps calcified tubercle) of ileum; there was no evidence of old tuberculosis in lungs.* Age was twenty-six years. Death occurred as the result of a bomb wound of the brain, bronchitis and bronchopneumonia. In the X-ray plate from the lung are two minute shadows less than 0.5 mm. across and situated at the apex of the lung. The lung was hardened in formalin and sectioned into pieces 0.3 mm. in thickness, but no nodules were found. In the mesentery corresponding with the ileum were numerous firmly calcified masses, the largest of which was 1.5 cm. across. Situated in the mucosa of the ileum about 3 cm. from the ileocaecal valve was an elevated calcified nodule about 3 mm. in diameter.

AUTOPSY 24. *Healed calcified tuberculosis of mesenteric lymph nodes; there was no tuberculosis of the lungs.* Age was twenty-one years. Death was the result of a penetrating wound of the brain, a metal fragment being lodged within the cerebrum. Adhesions bound the right pulmonary apex to the chest wall. The X-ray plate of the lungs contained a minute shadow 1 mm. in diameter which was suspected of being a calcified nodule; but sections of the lung hardened in formalin and cut from 2 to 3 mm. in thickness failed to reveal any suggestion of healed or other tuberculosis. In the mesentery of the jejunum was a group of firmly calcified lymph nodes about 1.5 cm. across.

AUTOPSY 28. *Healed calcified tuberculosis of the mesenteric lymph node; no evidence of tuberculosis of the lung was found though a minute shadow suggesting a calcified nodule in the substance of the lung was seen in the X-ray plate.* Age was nineteen years. Death was caused by a penetrating wound of thigh and wounds elsewhere, with fragments of metal lodged in the tissues and gas gangrene. In the X-ray plate (plate 2, fig. 3) a round shadow 3 mm. in diameter was seen near the outer edge of the upper lobe of the right lung; but on section of the hardened lung into thin pieces no nodule was found. No

shadows were found in the X-ray plate at the hilum of either lung and the lymph nodes contained no evidence of tuberculosis. At both apices the pleura was thickened. In the mesentery of the ileum (plate 2, fig. 3) there was a calcified lymph node 1.2 cm. across.

Autopsy 32. *Healed calcified tuberculosis of mesenteric lymph node; no tuberculous lesions were found in lungs.* Age was thirty years. Death occurred with gas gangrene following amputation through the right thigh for gun shot wounds; there was contusion of the chest. In the lung sectioned into pieces 3 mm. in thickness no tuberculous lesions were found. In the mid-part of the mesentery, about 3 cm. from the intestine, is a firmly calcified body 1.5 cm. x 8 mm.

Autopsy 41. *Healed calcified tuberculosis of mesentery; calcified nodule near apex of left lung; obliteration of pleural cavity on left side.* Age was twenty-one years. Death occurred as the result of a penetrating wound of the cerebrum. The left pleural cavity is obliterated by adhesions; and there are a few adhesions on the right side. In the X-ray plate there is a round shadow, 2.5 mm., near the left apex; but none is seen at the hilum. (There is no note concerning the examination of the lung hardened in formalin.) The mesentery contains a small calcified nodule 3 mm. across.

Autopsy 42. *Calcified tuberculous lymph node of mesentery; the lungs showed no evidence of tuberculosis.* Age was twenty-three years. Death occurred as the result of a lacerated wound of the left thigh followed by gas gangrene. The lungs sectioned into pieces, 0.5 cm. thick, show no evidence of tuberculosis. Near the mid-part of the mesentery is a firmly calcified nodule, 1.5 x 1 cm.

Autopsy 45. *Extensive calcified tuberculosis of mesentery; no tuberculosis of lungs was found.* Age was twenty-four years. Death was the result of a penetrating wound of the chest with a piece of metal lodged in the right lung and abscess formation. The X-ray plate (plate 2, fig. 4) showed a piece of metal near the base of the right lung. The lungs, sectioned after hardening to 3 mm., showed no evidence of tuberculosis. In the mesentery (plate 2, fig. 4) was a group of calcified nodules close to the ileocaecal valve. They were continuous with a mass of calcified lymph nodes, of which the largest was 2 cm. across, situated at the base of the mesentery. Another group of calcified lymph nodes was scattered in the mid-part of the mesentery near the intestine, about 20 cm. from the ileocaecal valve.

Autopsy 44. *Calcified tuberculous lymph nodes of the mesentery; the lungs contained no evidence of tuberculosis.* Age was thirty-one years. Death occurred with suppurative bronchopneumonia following mustard gas poisoning. In the lungs (plate 3, fig. 5), sectioned after hardening to 3 mm., no tuberculous lesions were found, though in the X-ray plate there was a round shadow suggesting a calcified nodule in the lower part of the right upper lobe. There

was no shadow at the hilum. In the mesentery (plate 3, fig. 5), corresponding with the mid-part of the ileum, there were a considerable number of calcified masses, two of which were 1.2 and 1.5 cm. across.

AUTOPSY 72. *Small calcified encapsulated tubercles in lymph nodes of mesentery; no tuberculosis was found in lungs.* Age was thirty-two years. There were penetrating wounds of the thighs, with fracture of the right femur and gas gangrene. No evidence of fresh or old tuberculosis was found in the lungs at autopsy. In the mid-part of the mesentery was a lymph node, 6 mm. in length, containing an encapsulated nodule, 1.5 mm. across, with a calcified centre. In another node was a similar nodule 1 mm. across, with a firmly calcified centre.

AUTOPSY 77. *Calcified tuberculous masses in mesentery; no tuberculosis of lungs was found.* Age was twenty-three years. Death occurred as the result of a penetrating wound of the vertebral column, severing the spinal cord and followed by suppurative meningitis. In the lungs examined at autopsy there was no evidence of tuberculosis. Midway between the intestine and the base of the mesentery there was a firmly calcified mass 2 x 1 x 1 cm.; and nearby was a second calcified nodule 4 mm. across, over which the peritoneum was puckered.

AUTOPSY 82. *Healed calcified tuberculosis of mesenteric lymph nodes; no evidence of old or recent tuberculosis was found in the lungs.* Age was twenty-seven years. Death occurred with multiple wounds of face and limbs, amputation through right thigh and suppurative bronchopneumonia. No evidence of old or recent tuberculosis was found at autopsy in the lungs or in the adjacent lymph nodes. In the mesentery was a round calcified nodule 13 mm. across; and nearby were three smaller nodules.

In a series of autopsies made in St. Louis, evidence of first infection with tuberculosis was found in the lungs of every adult examined. This first infection may be regarded as a spontaneous vaccination which confers immunity during the period of its activity at least. The associated immunity like that of experimental animals is doubtless relative and not absolute, so that under favorable conditions reinfection may occur. Apical tuberculosis, which usually pursues a chronic course and in most persons undergoes complete healing, has been found in the lungs of 22 per cent of adults above the age of eighteen years included in the former study. In two of eighteen instances of partially or completely calcified tuberculosis of the mesenteric lymph nodes herewith described (and perhaps in a third, namely, autopsy 41) there has been apical tuberculosis of the lungs, which, unlike the primary focal lesions of the lung, is unaccompanied by evidence of tuberculosis of the adjacent lymph nodes at the hilum of the lung.

AUTOPSY 12. *Calcified lymph node in the mesentery near the ileocaecal junction; fibroid tuberculosis near the apex of the right lung with calcification; a calcified nodule below the pleura and another in the lung substance, adjacent to right apex, together with old pleural adhesions.* Age was twenty-two years. Death occurred as the result of suppurating shrapnel wounds of the brain and elsewhere. Near the apex of the right lung there was an indurated area about 3 cm. across, containing gray nodules and one spot of calcification. Corresponding with firm adhesions along the posterior border of the upper lobe, there was a calcified nodule, 3 mm. across, below the pleura; and in the lung substance, just below it, a smaller nodule. In the mesentery near the ileocaecal valve there was a calcified lymph node, 1.2 cm. in diameter.

AUTOPSY 22. *Calcified tuberculous lymph nodes of mesentery limited to ileocaecal region; chronic apical tuberculosis of right lung.* Age was twenty-one years. Death occurred as the result of a penetrating wound of the chest wall, spleen and thoracic vertebrae, with a metal fragment lodged in contact with the spinal cord which was compressed. At the apex of the right lung (plate 3, fig. 6) was a nodular tuberculous mass occupying the upper 5 cm. of the organ, the surface of which was puckered and adherent to the chest wall. In the mesentery of the ileocaecal region there were two calcified nodules, each about 1 cm. across.

The following instance of tuberculosis in a Cornish miner is of interest because, in association with firmly calcified tuberculosis of the mesenteric lymph nodes, there was active tuberculosis of abdominal and thoracic lymph nodes, together with tuberculosis of the pleural and pericardial cavities. There was advanced anthracosis of the lungs, but no pulmonary tuberculosis was found. It is not possible to determine what part anthracosis of thoracic and abdominal lymph nodes has had in favoring or retarding the spread of lymphatic tuberculosis in this case.

AUTOPSY 78. *Healed calcified tuberculous lymph node of mesentery; caseous tuberculosis and anthracosis of anterior mediastinal, peritracheal, peribronchial, peripancreatic and retroperitoneal lymph nodes; anthracosis of lungs and of pulmonary lymph nodes but no pulmonary tuberculosis.* The patient was aged thirty-six years, a member of a labor battalion and a resident of Cornwall. Death occurred with disseminated tuberculosis and with anthracosis of the lungs.

Anatomical diagnosis: Chronic tuberculous pleurisy and pericarditis; active tuberculosis of peritracheal, peribronchial, anterior mediastinal, hepatic, peripancreatic and retroperitoneal lymph nodes; calcified nodule in mesentery; anthracosis of lungs, of pulmonary, peribronchial, peritracheal, peripancreatic, hepatic and retroperitoneal lymph nodes and of spleen.

The lungs were adherent to the mediastinum, in which occurred caseous lymph nodes, the largest of which were 2 cm. across. The left lung was adherent at the apex and the left cavity contained serous fluid. The right pleural cavity was partially obliterated. There was fibrin on the surfaces of the pleura and caseous material within the pleura. The pericardial cavity was obliterated; and within the epicardium were grayish white nodules. Peritracheal and peribronchial lymph nodes were greatly enlarged, densely hard and black with coal pigment; they contained caseous foci. The lymph nodes about the liver and pancreas and in the retroperitoneal tissue were bluish black and in places tough and airless. There was no evidence of active or healed tuberculosis, either in the lungs or in the anthracotic lymph nodes within the lung substance. In the spleen, along blood vessels, were well defined lines of anthracotic pigmentation. The mesentery of the ileum contained a calcified nodule of irregular outline, 6 x 3 mm.

The calcified nodule found in the mesentery in this instance cannot be regarded as an instance of healed tuberculosis, for it is possible that the active tuberculosis disseminated within the lymphatic system and in serous cavities had its origin in this older lesion. This autopsy has not been included among instances of first infection by way of the mesentery although it is probable that the primary source of infection was the gastrointestinal tract.

The foregoing study of tuberculosis in adults who, with one exception, have died with conditions wholly unrelated to tuberculosis has shown that evidence of first infection with tuberculosis may be found in the mesenteric lymph nodes of one of every four young British adults, whereas similar lesions are relatively uncommon in this country. The greater frequency of tuberculosis among cattle in Great Britain suggests itself as an explanation. It is noteworthy that in those in whom these mesenteric lesions occur focal tuberculosis of the lung is scant or absent. Table 1 in the foregoing article (1) indicates the relative extent of calcified focal tuberculosis of the lungs in a series of adults examined in St. Louis. It is significant that, in contrast with this series of moderate and extensive pulmonary lesions, focal tuberculosis of the lung was not found in any instance of mesenteric tuberculosis. In autopsies 13, 24, 28, 41 and 44 small shadows suggesting focal lesions were found in the X-ray plate; but corresponding lesions were not demonstrable in the lungs sectioned into thin slices after hardening. In none of these lungs were corresponding shadows found at the site of the lymph nodes at the hilum of the lung. Although focal lesions are inconspicuous if not wholly

absent, primary infection of the mesentery does not prevent tuberculous infection of the lungs, for healed apical tuberculosis has occurred in two instances; and in one instance there has been active widespread tuberculosis of the lymphatic system. The evidence available indicates that first infection with tuberculosis does not uniformly prevent a second infection but modifies its course so that it tends to become chronic and exhibits little tendency to become disseminated.

Lesions of the intestine, corresponding to those of the mesenteric lymph nodes, doubtless tend to disappear; for caseous material within an intestinal ulcer is rapidly disintegrated and removed. In one instance, namely in autopsy 13, a calcified nodule was found in the intestinal mucosa of the ileum.

When healed lesions are present in the mesentery focal tuberculosis of the lungs is seldom found. First infection with tuberculosis may occur by way of the lungs or by way of the gastrointestinal tract; and the occurrence of one lesion tends to prevent the other.

REFERENCE

(1) Opie, E. L., and Andersen, H.: First infection with tuberculosis by way of the lungs. Amer. Rev. Tuberc., 1920, iv, 629.

PLATE 1

Fig. 1. X-ray plate showing calcified tuberculosis of the lungs and adjacent lymph nodes with no tuberculosis of mesentery.

Fig. 2. X-ray plate from autopsy 43 showing beginning calcification in a caseous lymph node of the mesentery and no tuberculosis of the lungs.

Fig. 2

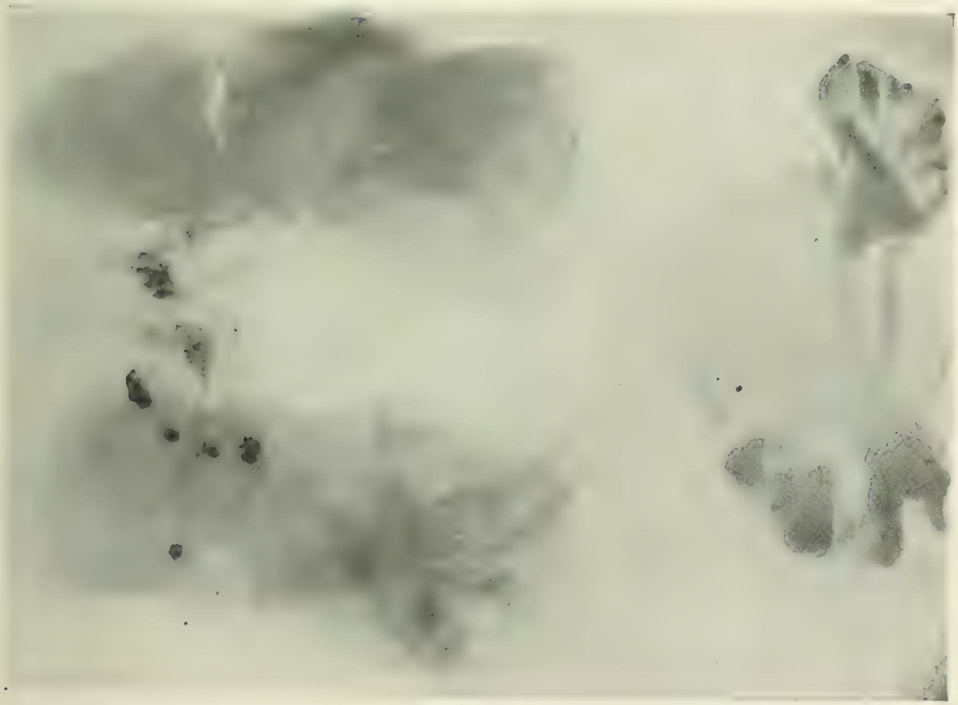

Fig. 1

PLATE 2

Fig. 3. X-ray plate from autopsy 28 showing large calcified lymph node of the mesentery. There is a small round shadow suggesting calcification in the substance of the lung but none in the region of the lymph nodes at the hilum.

Fig. 4. X-ray plate from autopsy 45 showing extensive calcified tuberculosis of mesenteric lymph nodes; no calcified nodules are shown in the lungs. A metal fragment which caused death is embedded in the lung.

PLATE 2

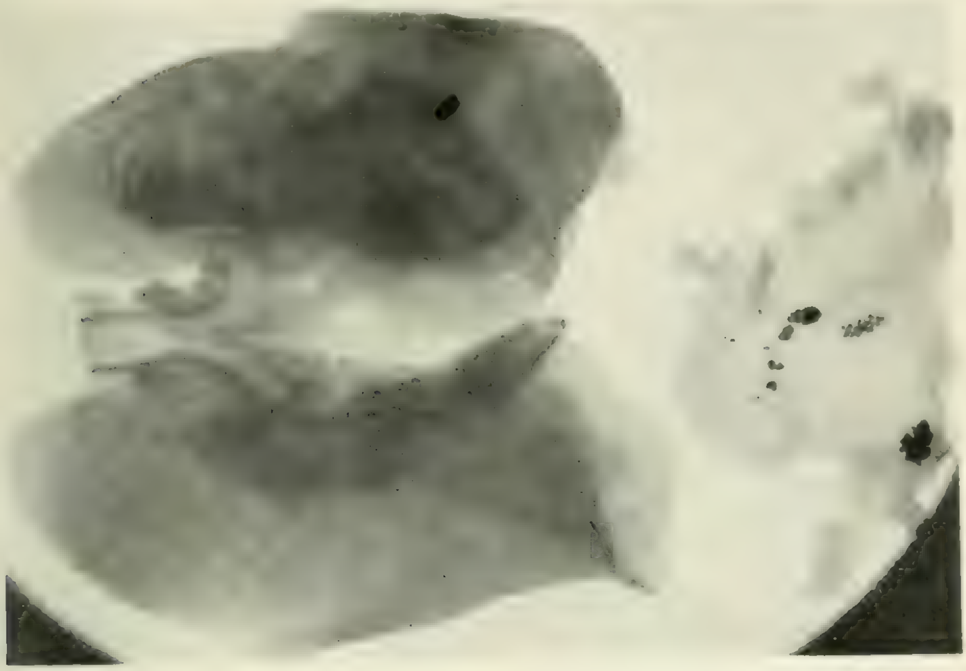

FIG. 4

FIG. 5

PLATE 3

Fig. 5. X-ray plate from autopsy 44 showing calcified tuberculosis of mesenteric lymph nodes. There are two small round shadows in the substance of the lung but none in the region of the lymph nodes at the hilum.

Fig. 6. X-ray plate from autopsy 22 showing tuberculosis of mesenteric lymph nodes and apical, partially calcified, tuberculosis of the lung.

Fig. 6

Fig. 5

A CASE OF ARTIFICIAL PNEUMOTHORAX COMPLICATED BY HYDROPNEUMOTHORAX AND PLEURISY WITH EFFUSION IN THE UNTREATED SIDE

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Experience with artificial pneumothorax has taught that we may expect effusions in the treated pleural cavities in from 50 to 75 per cent of cases. As long as the fluid remains serous, the prognosis is fair, or even good. The fluid may be small in amount and disappear within a few weeks. When copious, it assists in keeping the affected lung collapsed and at rest, thus doing what we expect to accomplish with the inflated gas. It has also been stated that certain biochemical reactions are brought about by the fluid which promote cicatrization of the tuberculous lesion, as can be seen at times when a small amount of fluid, which cannot assist much in compressing the lung, and which is quickly absorbed, is instrumental in detoxicating the patient and promoting healing of the lesion much more quickly than would ordinarily be expected.

It is, however, different when, after collapsing a lung by artificial pneumothorax, an effusion appears in the untreated pleura. Here for mechanical and functional reasons we would expect the danger to be immense. When the lung is completely collapsed by air in the pleural cavity, the breathing area is reduced by about one-half. An effusion into the untreated pleura will reduce the lung's breathing area by as much as that fluid succeeds in compressing it. If the effusion is copious it may fill one-half, or more, of the pleural cavity, doing away with that much of functionally active lung, and only about thirty-three per cent, or less, is left for normal function.

This is apparently of rare occurrence. Forlanini, who treated hundreds of cases with therapeutic pneumothorax, never met with a case. Neither has Saugman. Brauer and Spengler (1) in their recent study on pneumothorax state that there is no record of such a case in medical literature, and that they had not enountered one in their extensive experience. However, in a recent number of the *Zeitschrift für Tuber-*

kulose. Emil Als (2) reports a case and says that it is the only one so far recorded in medical literature.

In this connection, the following case may prove of interest. Here we observed an effusion into the pleural cavity in which a pneumothorax was created, and another one in the untreated side.

B. K., twenty-six years, housewife, admitted February 2, 1919. Married for five years, one child four years of age. She felt well till June, 1918, when she began to cough. At times this was of the emetic type. Has had fever, nightsweats, etc. Consulted a physician who informed her that she had tuberculosis and advised climatic treatment. She went to the mountains and remained there till the end of December, 1918, when she returned to the city feeling much improved. But within a few weeks the fever, cough, nightsweats, etc., returned and she was told that her trouble was mainly due to influenza and bronchopneumonia. When the writer was consulted in January, 1919, no signs of influenza or bronchopneumonia could be found, but the symptoms and signs showed a frank case of advanced pulmonary tuberculosis, with an extensive excavation of the upper and middle lobe of the right lung and slight infiltrative changes in the left apex. Because of the activity of the process and the gloomy outlook, an artificial pneumothorax was suggested.

She was soon admitted to the Montefiore Hospital; and on February 12, 1919, the first puncture was made in the sixth right interspace in the axillary line. Excellent negative pressure was found and 350 cc. of air was allowed to enter the pleura. On alternate days further inflations were made, until about 3000 cc. were injected, when the lung was completely collapsed. She apparently absorbed the air more quickly than usual and refills were necessary at very frequent intervals. However, the temperature showed a tendency to decline within a few days, and in two weeks it reached normal and stayed there for about six weeks. Concurrently her cough disappeared, her appetite returned and her general aspect improved to an extent as to encourage her very much.

During the last week of May she began to complain of frontal headache, pain in the chest and her temperature rose to 103° F. Within a few days signs of fluid, flatness, succussion, etc., were discovered in the right side of the chest. Exploratory puncture brought out clear, lemon colored serum. Within a few weeks the temperature again declined to 101° F., though the fluid in the right pleura remained, filling about one-third of the cavity but showing no tendency to increase in amount. As is usual in these cases, we permitted the patient to take mild exercises as long as the temperature was not much above 100° F.

On June 20 the patient began to complain of severe, stabbing pain in the left chest, and the thermometer registered 101° F., and three days later even 103° F. Within a few days, examination showed no change in the resonance of the left side of the chest, but a soft friction was audible over the lower half in the anterior axillary line. On June 30 the pain in the left chest disappeared, but an examination disclosed signs of an effusion into that pleura. Especially suggestive of fluid was flatness over Traube's semilunar space. A radiogram confirmed the findings on physical examination. Exploratory puncture brought out clear, straw colored fluid.

The fluid kept on increasing in the left side, while in the right side of the chest there was a hydropneumothorax, but the patient felt quite well, though now and then she would suffer from attacks of dyspnea and cyanosis which were quite acute; but rest and encouragement would soon bring about an improvement. Because of these acute symptoms we on two occasions aspirated the left pleural cavity, obtaining about 200 cc. of fluid. I then resorted to autoserotherapy, withdrawing in an aspirating syringe 5 or 10 cc. of fluid and reinjecting it subcutaneously, every three or four days.

During the middle of August, after the upper level of the fluid in the left pleural cavity had reached the fourth rib, it began to disappear, the upper level coming down lower and lower. With this there was also to be noted a gradual decline of temperature, and an improvement in the breathing and general well-being of the patient. It is noteworthy that with the absorption of the fluid from the left pleural cavity the fluid in the right side, the hydropneumothorax, also was absorbed. By the end of September the temperature was normal and remained so for over a month. With the absorption of the fluid the pain in the left chest returned. But her general condition kept on improving, the cough became slight, and she gained in weight. At her own request, she was discharged in very good condition October 8, 1919.

This case has some interesting phases. It may be said that at the time when the fluid in the left chest filled one-half of the pleural cavity while the hydropneumothorax compressed the right lung completely, hardly more than one-half of the breathing area of the lung remained fit to perform the function of respiration. Still the patient was not constantly cyanosed, though her breathing was at times labored and almost always rapid. Slight exertion or excitement brought about dyspnea and cyanosis, but after rest and encouragement she felt comparatively comfortable. Moreover, these effusions in both sides of the chest did not interfere with the immediate salutary outlook; the immediate prognosis remained good, and she improved to an extent as to be fit for discharge with the advice that she seek climatic treatment.

It should be added that as soon as the left pleural cavity was filled with fluid we discontinued the inflations of gas into the right pleura. After the absorption of the fluid in the right side, the adhesions of the pleura prevented further inflations. But inasmuch as the constitutional symptoms of active tuberculosis abated, there was no reason for recommencing pneumothorax treatment.

REFERENCES

(1) Brauer and Spengler: Handbuch der Tuberkulose, 1919, iii, p. 227.
(2) Als, E.: Ein Fall von rechtsseitigem Pneumothorax artificialis mit linksseitiger Pleuritis exudativa, Zeitschr. f. Tuberk., 1920, xxxi, 333.

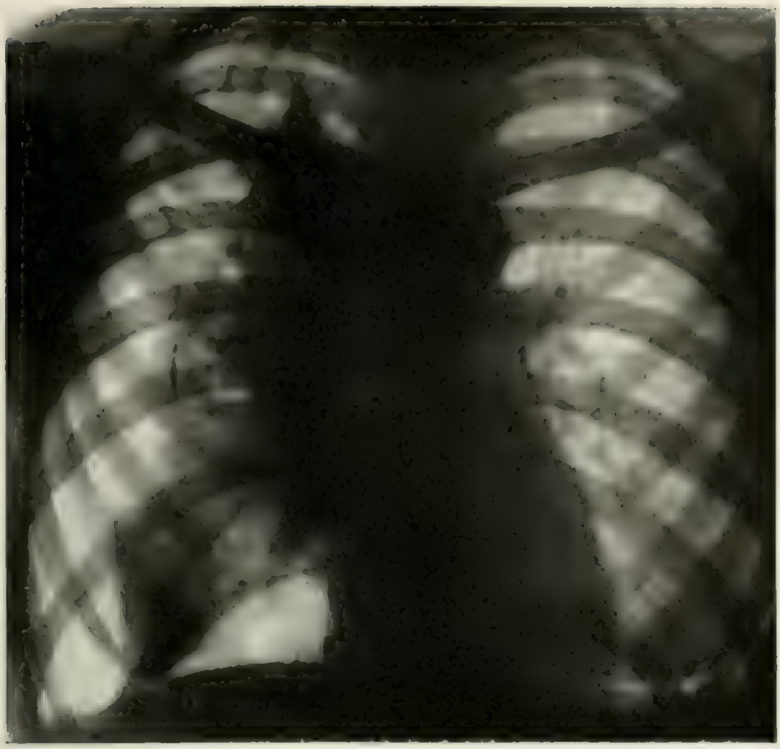

FIG. 1. PNEUMOTHORAX IN RIGHT SIDE OF CHEST. TAKEN MARCH 10, 1919

FIG. 2. HYDROPNEUMOTHORAX IN RIGHT CHEST: PLEURAL EFFUSION IN LEFT CHEST. TAKEN JULY 1, 1919

A ROENTGENOLOGICAL STUDY OF INFLUENZA, WITH RECOVERY, IN AN ADVANCED CASE OF PULMONARY TUBERCULOSIS

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It does not seem justified to draw elaborate conclusions regarding the effect of influenza bronchopneumonia upon pulmonary tuberculosis in man from the study of a single case; but it was thought that a series of roentgenological pictures taken upon a far advanced open case of pulmonary tuberculosis, passing through and recovering from an attack of influenza, would help elucidate this intricate subject. As has been frequently pointed out, it is true that pulmonary tuberculosis is a disease influenced by multiple factors difficult of analysis; but it seems that the point of primary interest to us from an elemental standpoint should be whether influenza has any effect upon the anatomic amount of tuberculous involvement of the lungs, as observed before and following this acute disease. Fortunately this may well be depicted in a series of roentgenographs.

Since the passing of the influenza epidemic of 1918–1919 there have appeared in the literature a number of important contributions made as a result of studies upon groups of consumptives, those contracting influenza while afflicted with pulmonary tuberculosis and being resident in sanatoriums as compared to nontuberculous residents likewise observed; and studies, truly only relative, on the incidence of newly developed or recrudescent pulmonary tuberculosis in cases having been afflicted with influenza and those not so affected, although the latter group is imperfectly considered in most studies, probably because of the difficulty encountered in obtaining accurate data. The majority of observers seem inclined toward the view that consumptives were in some unknown way less susceptible to influenza during the epidemic and that pulmonary tuberculosis was not to be feared as a grave sequela to the epidemic, although there are a few studies seemingly pointing to an opposite conclusion.

As a result of the study of 173 consumptives in the St. Blasien Sanatorium in Germany, of whom 40 developed influenza, and 90 nontuberculous individuals of whom 40 also developed influenza, Rickmann (1) concludes that the location and course of the pneumonias were not influenced by the character and amount of tuberculous involvement of the lungs and that the danger of spread of the tuberculous process after influenza was slight when immediate treatment was instituted. The cases with a large amount of tuberculosis were markedly incapacitated by pneumonic infiltrations into healthy tissues and the consequent easily induced cardiac failure.

Hawes (2), as a result of the study of the epidemic in Massachusetts, believed that an acute attack of influenza, usually associated with bronchopneumonia of greater or less severity, had remarkably little effect on the already existing tuberculous process as far as increasing its spread or its activity is concerned. Stivelman (3) reviewed the influenza epidemic among 175 tuberculous patients and 50 nontuberculous employees at the Montefiore Home Country Sanatorium and concluded that pneumonic consolidations occurred as frequently in the nontuberculous as in the tuberculous, and that careful observations for four months and reëxamination of all the patients affected with influenza showed them none the worse for the experience, their general condition being as good as might be expected normally. He also noted no increase in the number of tuberculous patients seeking admission to the sanatorium as a result of influenza. Murphy (4) found no measurable increase in the incidence of tuberculosis as a result of the influenza epidemic and cites Landis as warning against calling the persistent and slowly resolving patches of influenza-pneumonia tuberculosis. He also points out that known cases of tuberculosis are going to offer considerable difficulty as to whether the increase in physical signs is due to an extension of the tuberculous process, or a slowly resolving influenza pneumonia which is clearing up. Gram (5), as the result of a detailed survey in Buffalo, comes to the conclusion that there is nothing to be feared as regards tuberculosis as a sequel to influenza. Anderson (6) also points out, as a result of clinical studies, that there was no particular tendency for influenza to reactivate old arrested lesions. Although there were a great many diseased conditions of the lungs that have persisted since the epidemic, careful study showed that very few are actually tubercu losis. Fishberg (7) likewise believes that epidemic influenza has no etiological relation to tuberculosis and is not to be considered as a reactivator of dormant tuberculous lesions.

Berghoff (8) reported his observations from Camp Grant on 30 cases of quiescent pulmonary tuberculosis, and found that of these 17 contracted influenza, 4 of the latter dying. Study of the remaining 13 cases of influenza revealed a reactivation of the tuberculosis with development of a positive sputum in 6, or 50 per cent. Amberson and Peters (9) in two contributions made from the Loomis Sanatorium state that influenza is likely to be particularly grave in cases of pulmonary tuberculosis with massive lesions and little pulmonary reserve, and that a not inconsiderable proportion of individuals with pulmonary tuberculosis suffer exacerbations or relapses as a result of this intercurrent infection. In a certain number of individuals—a number large enough to deserve serious consideration—epidemic influenza marks the inception of definite pulmonary tuberculosis which did not previously exist as clinical tuberculosis. Among those already tuberculous, influenza may to a varying degree reactivate quiescent or apparently inactive lesions. That a large number do not pursue such a course and escape definite permanent damage is not denied.

In this survey of the literature no reference was found to cases of pulmonary tuberculosis in which roentgenographs had been made before, during and for some time subsequent to the attack of influenza. It has therefore seemed desirable to record such a case, the following record being of further interest because it occurred in a far advanced consumptive, with cavities in the lungs and with a positive sputum, so that a *locus minoris resistentiae* so to speak, produced by the influenza attack, would certainly result in plentiful seeding of all parts of the lung, both those involved by influenza and those remaining free throughout the course of the acute disease.

CASE REPORT

Clinical record. The patient, a male, age thirty-seven years, an automobile assembler by occupation, entered the hospital December 13, 1919, complaining of cough, expectoration and loss of weight. He did not appear to be acutely ill; his general physical condition seemed to be fair; he was able to work for about four hours a day without provoking further constitutional symptoms; and his temperature varied from normal to 99.2°. On physical examination there was evidence of a chronic bilateral pulmonary tuberculosis with cavities at both apices. Tubercle bacilli were found in the sputum,—three to six bacilli to a field. Diagnosis: Advanced bilateral pulmonary tuberculosis with cavitation in both upper lobes. Two months after admission he devel-

oped influenza followed by bronchopneumonia. On physical examination there was evidence of consolidation of practically the entire right lung. The influenzal bronchopneumonia ran a severe course for fourteen days when the clinical symptoms became milder and associated with this there was evidence of a beginning resolution. The resolution, however, was slow and protracted. During the attack of influenza the sputum increased in amount and tubercle bacilli became much more numerous. At the present time, five months after the attack of influenza, the sputum is decreased in amount, tubercle bacilli are present, from three to six to a field, and the physical signs and roentgenological plates indicate that the patient's pulmonary condition is about the same as upon admission. The maximum temperature is 99.2°F.

ROENTGENOLOGICAL FINDINGS[1]

Before the advent of influenza. (Fig. 1.) The right apex is completely consolidated, the apical bronchus being obliterated. The first interspace bronchus is densely consolidated and there is a well defined cavity. The second interspace is densely outlined with dense consolidations and multilocular cavities. The third interspace bronchus is densely outlined and there is some consolidation toward the mediastinum. The interlobar fissure is not visible. The lower lobe bronchi are densely outlined with a few scattered consolidations toward the mediastinum. The left apex is consolidated. The first left interspace bronchus is densely outlined and there is a marked consolidation and cavitation. The second interspace bronchus is densely outlined and there is some consolidation. The third interspace bronchus is densely outlined and consolidated. The interlobar fissure is absent. The lower lobe bronchus is densely outlined and is more consolidated than the right lower lobe. The trachea is in the midline and the heart is in a normal position. The right diaphragm seems to be adherent to the right lung in the mid-mammary line, the left diaphragm and pericardium are adherent.

Four days after influenza began. (Fig. 2.) Findings are only modified by a marked inflammatory mottling extending downward into the right lower lobe. There is also an increase in the transverse cardiac diameter indicating cardiac dilatation. The left lung remained unchanged.

Twelve days after the onset of influenza. (Fig. 3.) The acute inflammatory increase in density of powder-puff variety (bronchopneumonia) has extended throughout the entire right lung while the left lung remains unaffected.

Six weeks after the onset of influenza. (Fig. 4.) The right lung involvement is now confined mainly to the base (resolution), while the left lung remains as before the incidence of the acute bronchopneumonia. The transverse cardiac diameter is still increased.

[1] These data are given in conformity with the ideas of Garvin, *War Medicine*, 1919, ii, 974.

Four months after. (Fig. 5.) The right lung has still an appreciable density at the base, while the upper and middle lobes are no more involved than before the incidence of the influenza. The left lung remains unchanged, while the heart has diminished to its original size.

Five months after. (Fig. 6.) There still remains a slight amount of increased density at the base of the right lung toward the mediastinum and along the bronchi. Otherwise this roentgenograph compares well with that obtained before the incidence of the influenza.

CONCLUSIONS

In view of the fact that tuberculosis, being a chronic disease, is susceptible to multiple individual and combined influences, it is rather to be expected that there is bound to be a decided difference of clinical opinion on any single factor in this disease among different groups of observers. It is not our purpose to enter into an elaborate consideration of all these factors, but merely to point out that certain types of inflammation, such as those produced by Corper (10) with croton oil, turpentine, capsicum and cantharidin, do not seem to accelerate tuberculosis in the guinea pig. As to influenzal bronchopneumonia we may state that in this case there has been no acceleration of the tuberculous process in the lungs five months after the influenza.

We wish to express our appreciation to Drs. H. J. Corper and H. Gauss for aid in the preparation of this paper and to Dr. W. W. Wasson for some of the roentgenological data.

REFERENCES

(1) Rickmann: Deutsch. med. Wchnschr., 1919, xlv, 39.
(2) Hawes, J. B., 2nd: Boston Med. & Surg. J., 1919, clxxx, 35.
(3) Stivelman, B.: New York M. J., 1919, cx, 20.
(4) Murphy, T. J.: Boston Med. & Surg. J., 1919, clxxxi, 266.
(5) Gram, F. C.: Jour. A. M. A., 1919, lxxiii, 886.
(6) Anderson, W. N.: Nebraska State M. J., 1919, iv, 332.
(7) Fishberg, M.: Amer. Rev. Tuberc., 1919, iii, 532.
(8) Berghoff, R. S.: Ibid., 1919, iii, 370.
(9) Amberson, J. B., Jr., and Peters, A., Jr.: Ibid., 1919, iii, 359 and 1920, iv, 71.
(10) Corper, H. J.: Ibid., 1919, iii, 605.

FIG. 1. BEFORE THE ONSET OF INFLUENZA

FIG. 2. FOUR DAYS AFTER BEGINNING OF INFLUENZA

FIG. 3. TWELVE DAYS AFTER ONSET

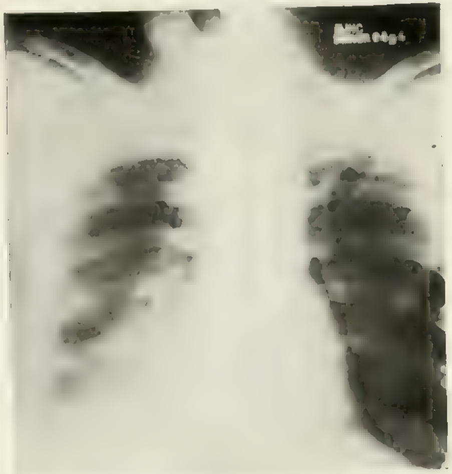

FIG. 4. SIX WEEKS AFTER ONSET

FIG. 5. FOUR MONTHS AFTER ONSET

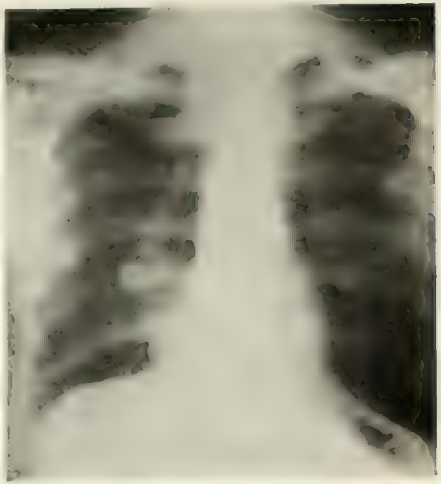

FIG. 6. FIVE MONTHS AFTER ONSET

MASKED JUVENILE TUBERCULOSIS[1]

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It is well known that evidence of previous tuberculous infection is almost universal among adults. The additional observation that probably the majority of these infections occur during childhood makes the question of tuberculosis of peculiar interest to the pediatrician, because upon his diagnostic acumen depends the recognition of many of these infected individuals. From the discrepancy between the incidence of definite clinical tuberculosis in children and the number of older children with positive skin reactions, it seems obvious that one must distinguish between tuberculous disease and infection with the tubercle bacillus, since many children who have been definitely infected do not show what we term clinical tuberculosis. There must be, therefore, a large group of children who are infected but develop sufficient immunity or resistance to overcome the infection, and possibly subsequent infections, without showing the usual signs and symptoms of clinical tuberculosis. In other words, many children are infected with the tubercle bacillus and thereafter, for a variable and unknown length of time, harbor somewhere in their bodies a pathologically active tuberculous focus the presence of which may go entirely unsuspected. It is to this group of cases that we wish especially to direct attention. Because the focus of infection is usually obscure, because they represent a type of lesion prevalent in childhood, and because we feel that they are neither inactive, latent or quiescent, we shall speak of them as *masked juvenile tuberculosis*.

In a recent study of a large number of children by the complement fixation test for tuberculosis made by one of us (1), it was noted that of the cases without manifest tuberculosis a certain group gave positive fixation reactions. This observation led to a more careful clinical study of these cases for evidences of tuberculosis. From this study we are satisfied that there is a fairly large group of children who have, in all

[1] Read before the Clinical and Pathological Sections, at the Sixteenth Annual Meeting of the National Tuberculosis Association, St.Louis, Missouri, April 23, 1920.

probability, some active focus of tuberculosis which is unrecognized in many instances, and that a large number of such cases may be detected by the complement fixation test.

METHODS

The technique used in carrying out the complement fixation reaction has been described previously (2) and will not be given here. It may be mentioned, however, that an emulsion of dried, powdered tubercle bacilli which had been grown on Dorset's egg medium and precipitated by alcohol was used as antigen. In the series of cases comprising this study 213 fixation tests were made on 131 children. In 41 instances the test was repeated on the same specimen of serum. The test was repeated on another specimen of blood in 25 cases, 3 times in 4 cases, and 4 times in 1 case.

For the purpose of this study, we have excluded all children showing evidence of open or manifest tuberculosis, whether of a medical or surgical nature. This at once eliminated cases of active bone tuberculosis, tuberculous cervical adenitis, pulmonary tuberculosis with bacilli in the sputum or those with chest findings so characteristic as to leave no doubt concerning the pathological process, etc. During the course of the study, which extended over a period of about two years, it happened on several occasions that a child in the group under observation developed a tuberculous cervical adenitis, Pott's disease, or other frank lesion. In such instances, the case was taken from the class of *masked juvenile tuberculosis* and placed in the *known tuberculosis* group, and not included in this series. An attempt was made to have the patients report to the dispensary at frequent intervals for examination, attendance being stimulated by a "follow-up" system and home visits by a social worker. The methods pursued in the study of the patients were as follows:

The history was not always reliable because among the poorer classes, who furnished the material for this study, tuberculosis frequently goes unrecognized and supposed minor ailments pass unnoticed. A record was made not only of the chief complaint for which the patient came to the clinic or hospital, but also of former illnesses, cough, exposure to tuberculosis, fever, anorexia, loss of weight, etc. Night sweats occur from such a variety of different causes in childhood as to be of no particular significance and for this reason questions concerning this symptom were not emphasized.

Repeated and careful *physical examinations* were made by each of us in almost every instance, chest findings being noted before roentgen ray and verified by study of the plates. In addition many cases were subjected to the more careful scrutiny of hospital study. In a few children the study was incomplete because of insufficient visits by the patient. The routine chest examination included a special search for evidence referable to enlargement of the tracheobronchial nodes, such as D'Espine's sign, and dulness to the right or left of sternum or spine.

Skin tuberculin tests were made on all patients studied, and in only 3 was this record incomplete because the child did not return for the reading. As a rule a Pirquet test was done on the first visit, and if this proved negative, 0.1 mgm. of tuberculin was injected intracutaneously. Certain patients had repeated tuberculin tests made.

A *roentgenogram* of the chest was obtained in all but 14 children of the series. In many instances a second plate was taken after the lapse of several months or a year, in order to note what change, if any, had taken place. Stereoscopic pictures are much more difficult to obtain in children than in adults and consequently we have had to depend almost entirely upon single flat plates for this phase of the examination. Stereoscopic plates, when they could be taken, were, of course, eminently more satisfactory than the flat plate.

Papulonecrotic tuberculides, *lichen scrofulosorum* and *phlyctenular keratitis* or *conjunctivitis* provoked our especial interest because they are known to bear a very close relationship to tuberculosis, even though their etiology is still the subject of debate. Search for tubercle bacilli in the sputum was made in relatively few cases, because it seemed unlikely that the type of case under study would yield positive results in this respect except in the rarest instances.

DISCUSSION

The cases of masked tuberculosis studied formed part of a larger group of 1556 children upon whom complement fixation tests were performed (1). The results in the 116 who had manifest tuberculosis, including chiefly pulmonary, meningeal and bone involvement, with some cases of generalized infection, are of interest. The test was universally negative in infants under one year of age and was positive in only two-fifths of the cases between the first and second years. From the third to the sixth year the percentage of positive reactions rose to 50, and with each succeeding year it increased rapidly so that between

nine and fifteen years of age 82 per cent of children with such active tuberculosis gave a positive complement fixation test. Another group of 556 cases with no evidence of tuberculous infection and with negative skin tuberculin reactions, gave only 19, or 3.4 per cent, positive reactions. Of 128 children who gave only skin tuberculin reactions, but no other evidence of tuberculous infection, 21, or 16.4 per cent, were positive. We were able to examine only 20 well children whom we had observed during an obviously active tuberculosis some years ago. These children had been free from all signs for from two to six years, and only 2 gave positive fixation reactions. These rather striking figures in themselves indicate that positive fixation tests accompany, in a very considerable proportion of cases, evidences of clinical activity in tuberculosis and are found in a relatively small proportion of children without such evidence.

While it is true that our interest was first aroused by a small group of children with positive fixation tests but without clinical tuberculosis, we soon found that upon more careful examination a considerable percentage of these children showed one or more evidences of abnormality which are frequently found in tuberculosis. Among these were paravertebral or parasternal dulness, D'Espine's sign, malnutrition or loss of weight, asthenia, anemia, occasional elevation of afternoon temperature, attacks of unexplained fever, cough, or phlyctenular conjunctivitis. Our attention having been attracted to such a group, we made an effort to study clinically all cases in which there was any suspicion of tuberculosis, in order to determine the significance of the fixation test in these cases. We soon found other cases with an identical clinical picture but with negative fixation tests. The group of children included in this study, therefore, has been selected primarily by clinical examination without reference to the result of the complement fixation.

Table showing result of complement fixation tests in masked juvenile tuberculosis

AGE IN YEARS	TOTAL NUMBER	NUMBER OF POSITIVE FIXATIONS	PERCENTAGE OF POSITIVE FIXATIONS
0–1	0	0	0
1–2	5	2	40
2–4	10	5	50
4–6	19	12	63
6–9	45	33	73
9–12	31	23	74
12–15	21	20	95
Total............	131	95	73

The results of the complement fixation test in this group are given in the table. It will be seen that no cases under one year of age are included, and only 5 in the second year. This is due to the fact that infants giving positive tuberculin skin tests were with a few exceptions considered to have a definitely active tuberculosis, and were, therefore, not included in the study. The groups of children over two years of age show a gradually increasing proportion of positive reactions as the age advances, from 50 per cent between the second and fourth years to 95 per cent between the twelfth and fifteenth years. This gradually increasing percentage of positive reactions follows closely a similar increase found in the group of manifest tuberculosis previously mentioned. It will be noted also that of the children over four years of age, there is a total of 116, of whom 76 per cent were positive. This, too, corresponds closely to the proportion of cases reacting positively between these ages in the group of manifest tuberculosis.

There appears to be no question that the complement-fixing substances in the blood of tuberculous individuals are quite distinct from those which produce the skin tuberculin reaction. We have shown that a group of children with manifest tuberculosis gave a high proportion of positive fixations, whereas a large number of control cases, without demonstrable evidence of tuberculosis, gave only a very small percentage of positive results. Another group, in which the only evidence of tuberculosis was a positive skin reaction, gave fixations in only a small number of instances (16.6 per cent). Moreover, 8 of the frankly tuberculous cases gave negative tuberculin tests, while 4 of these showed positive complement fixations. In explanation, it might be said that these were cases of tuberculous meningitis and miliary tuberculosis, in which the skin tests were made a few days before death. In such instances a negative tuberculin reaction is not unusual. It seems likely that whereas a positive Pirquet or intracutaneous reaction affords proof merely of infection by the tubercle bacillus, past or present, the fixation test is an expression of pathologic activity of that lesion. The parallelism between the percentage of positive fixations in the group of children under discussion and in those with manifest tuberculosis would in itself speak strongly for the conception that the former have some active focus of tuberculosis.

The figures quoted above, while striking, do not in themselves furnish absolute proof that the children under discussion had active tuberculous disease. Indeed, it is improbable that such proof can ever be obtained,

except through autopsy. No deaths have occurred in our series and in all probability the vast majority of children with masked tuberculosis overcome their infection and ultimately recover. There is, however, considerable additional evidence that these children harbor an active focus.

It is usually admitted that in children infected with the tubercle bacillus, the common sequence of events is that the organism enters the respiratory tract and produces an early involvement of the tracheo-bronchial glands, with or without much reaction at the portal of entry. One might expect, therefore, some of the earliest clinical evidences of infection to appear in the hilum glands, and consequently we have directed a great portion of our efforts to an examination of this region. In the group of cases under discussion, we have paid particular attention to the presence or absence of dulness to the right or left of the sternum and spine, D'Espine's sign and examination by means of the roentgen ray. Paravertebral or parasternal dulness was present in a little over four-fifths of the cases examined, and D'Espine's sign (not considered positive unless the whispered pectoriloquy extended beyond the second dorsal spine) was found present in an equal percentage. In only approximately half of the cases was it possible to obtain data regarding the history of a persistent cough, but in over 90 per cent of these children this symptom was present. Changes in voice and breath sounds, areas of impaired resonance, râles, etc., while their presence was occasionally noted, were for the most part conspicuously absent in the character of cases we are attempting to describe.

In performing the skin tests on large numbers of children, we have confirmed the observation made by others, that a positive intracutaneous reaction with 0.01 or 0.1 mgm. tuberculin is not infrequently found in children who have previously given a negative Pirquet test. The children here reported showed positive skin tests in all but 7 instances. Three of these were done during convalescence from one of the acute exanthemata, when a suppression of the reaction is not uncommon, while in the remaining four no intracutaneous test was performed. In all these cases, other signs were present which justified their inclusion in this group. The skin tests, therefore, indicate that practically all these children were exposed to tuberculosis. In 57 instances, there was, in addition, the history of contact with a clinically active case.

Although slight febrile reactions are considered quite significant as an indication of activity in tuberculous infection, the high incidence of

minor respiratory and other infections in pediatric dispensary practice makes one hesitate to attach too much importance to this symptom alone. However, in 82 of these 131 children, a temperature of 99.6°F. or higher was recorded at one or more visits to the dispensary. Certain cases which were in the hospital, where careful observations could be made, showed definite afternoon temperature elevations of from 1° to 2°. In other instances, periods of unexplained fever which lasted several days were noted. Temperature observations to be of value, therefore, must be made at frequent intervals and the observations continued over a considerable period of time. Such exact data it was impossible to secure in the type of dispensary cases we are reporting.

Malnutrition in dispensary patients frequently is an indication of insufficient food, but in an analysis of the children with masked tuberculosis the nutrition has been noticeably below the average. For example, in less than one-fifth of the cases was the nutrition what might be termed good. In about 40 per cent of the cases it was fair (slightly under the average weight for the age) while in an equal proportion it was distinctly poor, that is, 10 to 20 pounds underweight. There were no cases with extreme anemia, but, as might be expected from the state of nutrition, moderate grades of anemia were frequently encountered. In many instances advice was first sought because of a marked asthenia and anorexia. When, as a result of the diagnosis of masked tuberculosis, an antituberculosis regimen was ordered, improvement was often surprisingly prompt and marked.

The association of phlyctenular disease with tuberculosis needs no comment here, and this has in some instances been the initial factor in attracting our attention. In 20 children there was a fresh or recently healed phlyctenular keratitis or conjunctivitis. In 7 other instances there were tuberculous skin lesions, 5 of them being of the papulonecrotic variety and 2 of lichen scrofulosorum.

A roentgen ray picture of the chest was made in all but 14 of the 131 children, and proved a valuable adjunct to the clinical examination. We readily concede the impossibility of determining from a roentgenogram alone the exact nature of a lesion in the lung, but we consider it highly significant that without exception every one of the 117 children so examined showed deviations from the normal which were at least not incompatible with the diagnosis of tuberculosis and in most instances suggested this disease very strongly. Practically all cases showed an increase in the hilum markings, the shadows being most commonly of

a rounded, crescentic, or triangular shape. Often the hilum shadow was extended well out into the lung parenchyma in the form of a more or less extensive fuzzy mottling, studded here and there with small, discrete, sharply defined spots which suggested calcified nodules. Similar discrete spots were frequently visible throughout the diffuse hilum shadows. Thickening of the bronchial tree was commonly observed; and many times there was a well marked streaking extending from the hilum downward to an irregular diaphragm shadow. On the whole, there was a quite uniform agreement between the size and position of the hilum shadows and the paravertebral and parasternal dulness. The roentgen ray picture typical of masked tuberculosis, then, is that usually found in tuberculosis of the tracheobronchial nodes and frequently shows extension of the process into the lung parenchyma. In all examinations we have paid especial attention to signs of infection in the lung, because the finding of tuberculous foci in other portions of the body without pulmonary involvement is unusual in this locality. The diagnosis of some hidden focus elsewhere offers obvious difficulties; and, while we have borne this possibility in mind in studying the cases, we have been unable to secure any evidence of it.

The terms "bronchial gland tuberculosis" or "hilum tuberculosis" have not been employed to describe this group of cases, chiefly because of their somewhat limited scope. Although enlargement of the tracheobronchial nodes was frequent in our cases, we believe that this represents one phase of masked tuberculosis. Indeed it is quite conceivable that these glands may be entirely normal, and the chief lesions occur among the mesenteric group, or elsewhere in the body. In portions of the British Isles, for example, where alimentary infection is relatively more common, one would expect the foci of infection in masked juvenile tuberculosis to be located not infrequently in abdominal structures.

As to the fate of children with masked tuberculosis, three possibilities suggest themselves. The first of these, which we believe to be by far the commonest, is regression of the lesion with recovery. Indeed, it seems quite likely that these relatively harmless lesions may stimulate the body to produce certain protective substances against future infections, and thus constitute part of the defense mechanism against tuberculosis. A second outcome is the development of a more manifest tuberculosis through extension of the process; indeed, we have observed a child with relatively insignificant clinical signs who developed a spondylitis. The third possibility is the persistence of the masked

lesion or tuberculous focus to adult life with a possible later development of an active tuberculosis. The recognition of this masked form of tuberculosis becomes, therefore, a matter of the greatest importance, because the inauguration of an antituberculosis regimen results usually in prompt and lasting improvement to the patient, and insures, we feel, a reasonably good chance of recovery in a disease of notoriously uncertain outcome.

One possible application of this study has especially interested us. The frequent finding in adults of healed tuberculous foci which correspond to the juvenile rather than the adult type of tuberculous disease, as well as the high incidence of positive tuberculin skin reactions in older children, have led to some speculation regarding the original infection. It seems probable that in many cases this first infection occurs in childhood, but relatively few of such cases are recognized. We believe that, chiefly by the use of the complement fixation test, we have caught a number of children in the active phase of such early focal tuberculous infection.

From what has been said, therefore, it must appear that we believe that masked juvenile tuberculosis presents a sufficiently distinctive clinical type to deserve a prominent place in the category of tuberculous affections in childhood. The characteristic clinical picture may be briefly sketched as follows: a history of frequent coughs and colds, with or without known exposure to tuberculosis, attacks of unexplained fever, often with afternoon elevations, anorexia, loss of weight and asthenia. On physical examination, there is found more or less malnutrition, occasionally anemia, and chest signs referable to enlarged tracheobronchial nodes. In certain instances there may be in addition phlyctenular disease or skin tuberculides. The Pirquet or intracutaneous tuberculin tests are positive, and, in those over four years of age, three-fourths of the children give a positive complement fixation test for tuberculosis. The chest findings may be verified by the use of the roentgen ray which not infrequently reveals unsuspected lesions of varying size and age in the lung parenchyma as well. The diagnosis must of course rest not in any *one* of the points mentioned, but rather upon a review of all the findings; and there again we wish to emphasize the value of the complement fixation test in calling attention to this class of cases.

REFERENCES

(1) Cooke, J. V.: Complement fixation for tuberculosis in children. Am. J. Dis. Child., in press.

(2) Cooke, J. V.: Complement fixation with acid-fast bacteria. Jour. Infect. Dis., 1919, xxv, 452.

A COMPARISON OF GROSS TUBERCULOUS LESIONS IN WHITES AND NEGROES

AS BASED ON 150 AUTOPSIES

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The question of comparative rapidity and extent of tuberculous lesions in the colored and white races remains unsettled. Some would attribute the high mortality of the Negroes from tuberculosis to an inherent racial susceptibility; others, to unsanitary living conditions which are more or less dependent on their lower state of mental development. It is not the purpose of the present article to solve this important problem, but, as nearly as possible, to draw certain comparisons between gross tuberculous lesions found at autopsy. It is obvious that exact comparisons are hard to make, particularly in pulmonary lesions where the pathology is so complex and varied in different cases, and where the tendency at autopsy is perhaps to emphasize the pathological lesions that have a direct bearing on the clinical study of the case. It is true, however, that a series of autopsy findings observed by a single operator can be more closely correlated than if observed by several.

The observations of this paper were made on a series of 150 autopsies, performed by the writer on 75 colored and 75 white cases at the Cincinnati Tuberculosis Sanatorium. This institution has an annual death rate of more than 200, of which more than 50 per cent come to autopsy. At the beginning of this work, I had the good fortune to come in possession of the work of Dr. Kennon Dunham, whose researches on the pathology and X-ray picture of tuberculous lesions has greatly advanced our knowledge of the processes.

The great majority of the colored patients were either natives of Cincinnati or of the Southern states, and with rare exceptions were of the uneducated type. The white patients were comparable in intelligence to the class generally admitted to city charitable institutions. The average age of the colored at the time of death was thirty-five years and that of the whites forty-four years. Thirty-six per cent of the colored

and 21 per cent of whites were positive Wassermann cases. It might well be stated that, of more than 800 patients studied routinely by the Wassermann method, it was found that 34 per cent of the Negroes and 9 per cent of the whites when admitted had positive Wassermann sera, and that in the colored coming to autopsy the increase was only 2 per cent, while in the whites it was from 9 per cent to 21 per cent. This seems to substantiate the claim that luetic infections exert a more baneful influence on white than on colored people.

Duration of disease. An attempt to obtain accurate information in regard to the duration of the disease was futile, this being particularly true of the ignorant Negro. Certain hints, however, could be obtained which might indicate it. Of the Negroes, 29 gave a history of more than one year duration, the average of these being two years and twelve days. Thirty-nine gave a history of less than one year, the average being five and one-half months, giving a general average of one year and one month. One gave a history of life-time duration and in five the duration was unknown.

Of the whites, 32 gave a history of more than one year duration, the average of these being three years. Thirty-two gave a history of less than one year, the average being four months, giving a general average of one year and six months. Thirteen were unable to give an intelligent history, most of these being foreigners and unable to speak or understand English.

History of exposure. Under this heading we include any associations resulting in close personal contact with consumptives, such as members of the family, roommates or business associates. Of the Negroes only 22 gave a positive history; of the whites, 23. Eleven of the colored and 15 of the whites gave a probable history of exposure, leaving 42 of the colored and 37 of the whites entirely negative.

Pleural adhesions. Colored: The pleural sac was entirely obliterated on the left side in 23 cases; the right in 24; and a complete obliteration was present on both sides in 16. Localized adhesions were found as follows: Left apex, 20 times; right apex, 22 times; left base, 10 times; and the right base, 4 times. Bilateral adhesions were found in 55 cases, and unilateral in 20 (7 on the left side and 13 on the right).

White: The left pleural sac was obliterated in 26 cases and the right in 26. Complete obliteration of both sides was found 10 times. Localized adhesions were noted as follows: Limited to the left apex, 37 times; right apex, 31 times; left base, 5 times; and the right base, 8 times. Bilateral adhesions were found in 65 cases, unilateral in 9 (4 on the left side and 5 on the right), and 1 case was entirely free from adhesions.

Empyema and hydrothorax. Colored: In 3 cases empyema, and in 12 cases hydrothorax were found on the left side; while on the right 4 cases of empyema and 3 of hydrothorax were noted. In no case was a bilateral empyema found, but a bilateral hydrothorax was present 5 times.

White: Three cases presented a left sided and 2 a right sided empyema, and 1 case a bilateral. Hydrothorax was found on the left side in 4, and on the right side in 5 cases and bilateral in 5 cases.

Cavities. Colored: Cavities were located in the lobes as follows: Upper left, 50 times; upper right, 53 times; lower left, 26 times; lower right, 25 times; and the right middle lobe, 25 times. In 7 cases the entire upper lobe on the right side was excavated, and in 1 case the upper and middle lobes, and in 1 case the entire right lung was hollowed out by cavities. The left upper lobe was excavated in 7 cases, and in 2 cases the entire left lung was destroyed.

White: Cavities were found as follows: Upper left lobe, 56 times; upper right, 61 times; lower right, 34 times; lower left, 26 times; and the right middle lobe, 18 times. The entire upper left lobe was excavated 7 times; the entire left lung, 7 times; and the upper right lobe, also 7 times.

Extensive caseous pneumonic consolidations. These were located in the colored as follows: Upper left lobe, 25 times; lower left, 29 times; upper right, 25 times; lower right, 27 times; right middle lobe, 9 times. Aspiration bronchopneumonia was found 45 times in the left and 60 times in the right lung.

White: Upper left, 25 times; lower left, 15 times; upper right, 26 times; lower right, 18 times and 10 times in the right middle lobe. Aspiration bronchopneumonia was found 35 times in the left and 60 times in the right lung.

Marked edema and congestion. Colored: Extensive edema and congestion were found in the left lung in 42 and in the right lung in 58 cases.

White: Left lung, 57 cases; right lung, 67 cases.

Miliary tuberculosis. Colored: Miliary outspread from old tuberculous lesions was found in 7 cases and acute generalized miliary tuberculosis in 3 cases.

White: Miliary outspread was found in 12 cases and generalized miliary tuberculosis in 3 cases.

Larynx. These cases were examined with particular reference to ulcerations. Colored: In 43 cases the larynx and trachea were removed and examined. Of these, 32 or 75 per cent showed ulcerations. The ulcers were located as follows: Entire larynx a mass of ulcers, 2 cases; epiglottis, 5 cases; vocal cords, 19 cases and the trachea 6 cases.

White: Out of 40 cases in which the larynx was removed, ulcerations were found in 24 or 60 per cent. The ulcers were located as follows: Entire larynx ulcerated, 4 cases; epiglottis, 10 cases; vocal cords, 17 cases; and in the trachea in 5 cases.

Intestines. Colored: The intestines were removed and examined in 75 cases; macroscopic ulcerations were found in 57 or 79 per cent.

White: Out of 75 cases, ulcerations were found in 62 or 82 per cent.

An attempt was made to find some condition in the lungs which was constantly associated with intestinal ulcers. It was not found, however, inasmuch as some open cases with positive sputa and extensive excavations were associated with intestinal ulcers, while with apparently similar pulmonary conditions the intestines were free from ulcerations.

Frequently, in cases where no ulcers were found, submucous tubercles were present. Not infrequently, small ulcerations were beginning at the locations of these tubercles, and it is suggested that the ulcerations are formed from the breaking down of the tubercles in the lymphatics beneath the submucous layers. These rupture on the surface of the lumen and the ulcer spreads by involvement of the adjacent tissue.

It is interesting to note that perforations through all coats of the intestines occurred rarely. Of the entire series, only 3 such cases were found, 1 of which was in a colored and 2 in white patients. Death followed in a few hours after the occurrence of the complication. Of the 240 postmortems covering the period from which this work was taken, only 32 females were included, and of these 26 or 80 per cent showed intestinal ulcers. In other words, ulcerations of the intestines were no more frequent in the female than in the male sex.

Mediastinal and bronchial lymph nodes. Tuberculous lesions, either active or inactive, were found in 67 colored and 47 white patients. Unfortunately, in the earlier part of the work, the examination of these was more or less perfunctorily performed and a clear differentiation between the active and inactive lesions was not made. The observation, however, was made that, in young patients and the older ones that ran an acute course, the nodes were frequently enlarged and necrotic, while in the old chronic cases extensive fibrosis and calcification were more frequently found.

Tubercles in the liver, spleen and kidneys. Of the colored cases, tubercles were found in the liver 31 times, spleen, 39, and the kidneys, 29 times.

White: Tubercles were found in the liver in 24, in the spleen in 41 and in the kidneys in 20 cases.

Heart lesions. The following heart lesions were noted because we feel that they have a particular bearing on the outcome of the pulmonary tuberculosis. Cases showing myocardial degeneration are terminated more quickly than those where the heart retains its normal functioning power.

Colored: Gross evidence of myocardial degeneration was found in 54 cases.

White: The same condition was noted in 55 cases.

Hydropericardium was present in 34 of the colored cases, milk spots in 35, and adhesive pericarditis in 15 cases.

Hydropericardium was noted in 34 of the white cases, milk spots in 47 and adhesive pericarditis in 10.

The most frequent valvular condition found was a fibrosis affecting the bicuspid and aortic semilunar valves. These lesions rarely produced any disturbance in the function of the heart's action and for this reason will not be discussed. No condition of the vascular system was found to have a direct relation to tuberculosis. The fact, however, is significant, that 2 colored and 1 white case were diagnosed clinically as tuberculosis and sent to the sanatorium and later died from ruptured aortic aneurysm, and in none of these cases was there any active tuberculosis.

SUMMARY

In this series, the majority of cases, both colored and white, came under the heading of the chronic ulcerative type of pulmonary tuberculosis with the usual incidental complications. Emaciation was usually marked or extreme.

The pathologic changes found in this condition, generally speaking, were as follows: An old cavity at the apex, surrounded by considerable fibrosis and covered by pleural adhesions; and hard, fibrotic or caseo-calcareous lymph nodes at the hilum. From the initial apical lesion, the process spread downward, probably as the result of aspirated infectious material, until cavities were formed in the areas supplied by the various trunks. Surrounding the more recent cavities, fibrous connective tissue, but less noticeable, and various gradations of pneumonia were found. In some cases, the larger excavations remained localized in one lung, the other becoming infected by aspiration of large quantities of infectious material, resulting in a widespread caseous pneumonia and numerous fresh ulcerating cavities, causing a rapidly fatal termination. This complication occurred about equally in both the white and colored. If aspiration of large quantities of the infectious material did not take place, or other accidents occurred, large portions of one or both lungs became excavated, and large intercommunicating cavities occupied both lungs. In such cases, enormous quantities of fibrous connective tissue were found replacing the pulmonary parenchyma, and pulling together the cavities. Dense pleural adhesions were usually found over the involved pulmonary area. In the entire series, this complication was found most marked in a colored male. In this case, the two left lobes and the upper and middle right lobes were represented only by old cavities with dense masses of connective tissue, causing marked contraction and distortion. The patient was in a working condition, until an influenzal pneumonia involved the right lower lobe and caused a fatal termination.

Another pathological type, running a more rapid course, showed the following findings: Emaciation slight or moderate; the intrapulmonary, peribronchial and bronchial, the mediastinal, mesenteric and retroperitoneal lymph nodes particularly, and less frequently the other groups of thoracic and abdominal nodes, were greatly enlarged and filled with caseous necrotic material. Solitary tubercles were found in the spleen, liver and kidneys. The lungs showed large and small areas of caseous

pneumonia, with or without caseous pleurisy, a process similar to the generalized tuberculosis of early life.

This condition was recorded in both colored and white patients, but seemed to be somewhat more frequent in the colored; however, more material is needed to establish this fact.

In regard to the various complications, such as intestinal and laryngeal ulcerations, involvement of the spleen, liver and kidneys, empyema, hydrothorax and pneumothorax, there seemed to be little difference in the percentage of involvement or extent of lesions.

CONCLUSION

Comparative study of the pathologic lesions in negroes and whites dying from pulmonary tuberculosis shows no essential difference in type or extent; the majority can be classified as of the chronic ulcerative type.

A minor number of cases, both colored and white, suffer from the more acute puerile type of generalized tuberculosis, this condition apparently being more common in the negro than in the white race.

TUBERCULOSIS AMONG THE NEGROES

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It has been said that the disease tuberculosis is the penalty paid by the human race for violating the laws of Nature for the civilization of man, and it might be added to this that the greatest penalty is paid by the newest convert. Statistics show that the high-water mark has been reached and passed in mortality from tuberculosis in the United States as a whole. Palmer (1) quotes Hoffman as saying that available records from New York, Philadelphia and Boston in 1812 show that the mortality was 450 per 100,000 of population. He further states that from 1872 to 1891 the mortality in all available registration districts decreased from 339 to 245 per 100,000 of population. From 1891 to 1912 a further decrease to 166 is noted. This decrease is generally to be attributed to the education of the public in matters pertaining to health, and as a matter of fact is the result of society adjusting itself to the cramped quarters of civilization. The general health worker in his efforts to eradicate all diseases which sap the vitality of the race, the social worker in his efforts to adjust living conditions, and the specialized tuberculosis worker are all the natural products of civilization in its attempt to adjust itself to a living basis and this development, plus the inherited immunity of the race, is responsible for the lowered death rate from tuberculosis.

Any given community or race is infected with tuberculosis just in proportion as it departs from the highest standards of living. And the standards of living are learned by experience through congregation. Just as the human body adjusts itself to disease through compensatory changes, so complex society makes its adjustment to prevent the inroads of disease. No doubt the highest death rate from tuberculosis in this country as a whole has been reached and passed. This, however, is not true of all communities or races in this country, some of which have yet to reach their acme. Nature aids in this adjustment through

increased resistance to the offspring of the infected. Which is the more potential factor—man's experience or Nature's immunity—is a mooted question today.

Tuberculosis begins when people begin to congregate and increases until by inherited immunity and experience they adjust themselves. The Negroes represent a good example of this statement. In Africa it is generally conceded that tuberculosis is practically unknown and when introduced by the white man, it is present in the native as an acute disease, a fact brought out by Bushnell and others. During slavery in this country, tuberculosis was rare among the Negroes, a statement not to be substantiated by figures it is true, but too recent in the minds of many to be disputed. At the end of slavery, the Negro suddenly changed from a regulated open air life to the life of the white man in even more crowded and unsanitary quarters necessitated by circumstances or shiftless habits. He immediately became the prey of tuberculosis. This is especially true of those who congregated in the cities. In taking family histories of Negro consumptives it is quite common to find one who has lost five or more in his immediate family, showing it to be almost or quite a primary infection. Statistics in Virginia in 1917 show that 2.21 per cent more Negroes died of tuberculosis than whites. This condition will continue until by precept and example, by the "survival of the fittest," and by inherited immunity, the Negro adjusts himself to the changed condition of life, and I am of the opinion that mental development and responsibility will play the most important part. Mental development carries with it betterment of racial habits and changed environments, and the reduction of the death rate from tuberculosis in the Negro, as in the other races, will be accomplished by the betterment of the environmental conditions and a gradual change in detrimental racial habits more than through inherited immunity.

RESISTANCE

Our records show that under favorable conditions the Negro will respond to treatment for pulmonary tuberculosis. We have discharged to date some 325 cases, 102 of whom were admitted solely for segregation, having been classed as 3-C upon admission. Of the 223 admitted for treatment we have:

	APPARENTLY ARRESTED	QUIESCENT	IMPROVED	UNIMPROVED	PROGRESSIVE	DEAD
1. 16 or 7 per cent	7	4	4	1		
2. 84 or 38 per cent	13	29	24	11	6	1
3. 123 or 55 per cent	2	10	29	6	73	3
223 or 100 per cent	22	43	57	18	79	4

Discharged to date
- 22 or 9 per cent .... Apparently arrested
- 43 or 19 per cent .... Quiescent
- 57 or 26 per cent .... Improved
- 18 or 8 per cent .... Unimproved
- 79 or 35 per cent .... Progressive
- 4 or 2 per cent .... Dead

Of the 102 admitted for segregation, 52 died in the sanatorium and 50 were discharged progressive.

In order to get some real data on a subject which I had heard discussed pro and con by a great many physicians in general practice in the South as regards the resistance of the pure-bred Negro versus the mixed type, we graded our patients upon admission into three classes: the bright mulatto, some of whom are nine-tenths white, the brown mulatto and the black. Our records as per the appended tables show a

Black—81 cases

		APPARENTLY ARRESTED	QUIESCENT	IMPROVED	UNIMPROVED	PROGRESSIVE	DEAD
1	2	1	1	—	—	—	—
2	22	3	9	3	3	2	2
3	57	—	3	7	1	28	18
	81	4	13	10	4	30	20
Brown mulatto—124 cases							
1	7	4	1	2	—	—	—
2	33	5	7	11	6	3	1
3	84	1	5	12	3	42	21
	124	10	13	25	9	45	22
Bright mulatto—114 cases							
1	7	2	2	2	1	—	—
2	32	5	13	10	2	2	—
3	75	1	2	10	2	46	14
	114	8	17	22	5	48	14

small percentage more of improved cases among the bright mulatto (41 per cent of whom showed an improvement) than in the brown mulatto (39 per cent of whom showed an improvement) and better in both of these classes than the black (33 per cent of whom showed an improvement).

I am of the opinion that a test of mentality would show a much greater difference in favor of the developed over the undeveloped than is shown by the light over the black, and until further figures corroborate our data, showing the better resistance of the light or mixed type over the black, I think that this apparent better resistance shown by the mixed type over the pure-bred Negro is to be accounted for more through racial development than through inherited resistance. The mixed type has fewer of the characteristic traits which handicap the race as a whole. Love of ease and a carefree disposition are assets to one compelled to lie in bed for a long period of time, but when a carefree disposition amounts to irresponsibility and a total inability to grasp a serious situation until too late, it becomes most decidedly a handicap. This is particularly true of our discharged patients. Those who continue well are those who showed mental responsibility while "on the cure," and these were mainly of the educated class.

Experience in our work among the Negroes shows that it is all-important to get the confidence of this ease-loving, carefree patient, and impress him with the fact that he is a sick man and needs treatment and that this treatment will be absolute rest in bed in the open air for a long time. All of his former convictions have to be shattered and replaced with new ones. He believes, first, that to get into bed with "consumption" means certain death; second, that strong medicine is a specific for all ailments and when this has failed all has failed; third, that a closed room with all "cracks chinked" is the treatment for a "cold."

So new is our field and so deep-grounded is the conviction that consumption is incurable that great difficulty was experienced during the first year in getting cases to enter the Sanatorium and to remain long enough to effect a cure. Less difficulty is had now on account of the fact that practically all of our employees are discharged patients and they serve as a concrete illustration of the fact that tuberculosis is curable. Conversations between the incoming patient and the arrested case in the person of the employee are often amusing and instructive to the interested listener, and show with what effort he discards his former

ideas and his incredulity in the new. Concrete examples of the curability of the disease are helpful to all afflicted with tuberculosis, but with the Negro it is almost essential.

SUBACUTE DISEASE.

Forty-five of the 325 cases discharged to date were classed at subacute, or 13.84 per cent. Here again the greatest percentage was among the blacks, 15 of 81 or 15.55 per cent being classed as subacute. Fourteen of 124 brown mulattoes were classed as subacute or 11.22 per cent and 15 of 114 bright mulattoes or 13.15 per cent. These cases were all between the ages of fourteen and twenty-six, most of them of athletic build and gave a history of illness not exceeding three months. Six of them were discharged from the Army within that time with a clean bill of health. All showed upon physical examination large moist râles in two or more lobes and little or no fibrosis. All died within three months after being examined. A highly positive sputum and high temperature were universal in these cases.

HOOK-WORM AS A COMPLICATION

Adams (2) reports a striking parallelism of incidence between tuberculosis and hook-worm in a series of examinations made at Fort Oglethorpe and covering several Southern states. One would expect hookworm to be a frequent complication of tuberculosis in the hook-worm infected districts of the South, both on account of the sapped vitality and the actual trauma to the lung. A survey made by the Virginia State Board of Health showed southeastern Virginia and the south Piedmont districts of Virginia to have a hook-worm percentage of 14 per cent and 29 per cent respectively, and, although we draw heavily from these sections, a routine stool examination shows only three positives out of 350 specimens, or less than 1 per cent. Statistics compiled by the Virginia State Board of Health and the International Health Board (3) show that the Negro is infected with hook-worm quite as frequently as his white neighbor, though he does not suffer so severe a form of the disease, and in spite of this fact we show less than 1 per cent of infections from districts with an infection of 14 per cent and 29 per cent. Hook-worm as a complication is practically nil with us. As a predisposing factor we are unable to determine it on account of the fact that early infections could have cleared up.

SYPHILIS AS A COMPLICATION

A routine Wassermann taken at our institution shows 19 per cent men positive for syphilis and 12 per cent women. Compared with other institutions in our State of a different character, this percentage is low. Dr. W. F. Drewry of the Central State Insane Asylum for Negroes reports 30 per cent of the men positive for syphilis and 25 per cent of the women positive by the Wassermann test. Dr. Mann reports 33 per cent positive at the State Penitentiary. Our lower percentage is probably due to the fact that our patients are of a better class. Of the 16 per cent, positive for syphilis by the Wassermann test, 14 per cent or 2 per cent of the whole showed manifest diseases.

On cases showing a positive Wassermann and negative sputum after six examinations we begin syphilitic treatment at once, regardless of localization of physical signs in the chest, guided only by contraindications for the use of salvarsan. One showing a positive sputum and positive Wassermann, with no manifest lesion of syphilis, is given routine treatment for tuberculosis and, if improvement is shown, no syphilitic treatment is given. If no improvement is shown after a period of two months, syphilitic treatment is given. In eight cases showing positive sputum and positive Wassermann upon admission and no improvement after two months in bed, syphilitic treatment was given with the following results: three showed no improvement after six doses of salvarsan; two showed a sharp reaction after the first dose with all symptoms intensified and treatment was discontinued. Three showed a marked improvement in symptoms and signs.

Case no. 130 upon admission showed upon physical examination large moist râles from apex to base on the right and the same on the upper left. Sputum positive for tubercle bacilli, Wassermann positive for syphilis. Daily temperature to 101. Severe cough and profuse expectoration. General condition same after three months in bed; physical examination same. Syphilitic treatment begun and temperature dropped to normal after fifth dose of salvarsan. Physical examination at end of six months showed fine râles at upper right. Sputum positive: Wassermann negative.

Case no. 309. Involvement in right upper and left lower. Sputum positive for tubercle bacilli; Wassermann positive for syphilis. Syphilitic lesion noted on skin. Patient kept isolated for two months at absolute rest in bed. Temperature continued to 100° daily. Physical

examination same at end of three months. Referred for syphilitic treatment and upon readmission three months later, physical examination showed fine râles upper right. Temperature normal. Sputum and Wassermann negative.

Case no. 305. Slight involvement in right upper. Larynx inflamed, cords uniformly reddened and thickened. Sputum positive for tubercle bacilli and Wassermann positive. Patient acknowledged venereal infection. Temperature normal during entire stay at sanatorium, but throat condition progressive. Syphilitic treatment begun after two months and after third dose some slight improvement noted in throat condition. Case still under observation.

From the foregoing data it is noted that syphilis of the lungs is not so rare as is generally reported.

CONCLUSION

Tuberculosis is a disease of civilization and its eradication is to be accomplished by perfection in the standards of living of this civilization.

Data carefully compiled by us show that the mixed type of Negro has a better resistance to tuberculosis than the pure-bred Negro. Observations show, however, that shade of mentality counts for more than does shade of color.

Hook-worm as a complication of tuberculosis in the Negro race is quite uncommon. Syphilis is a common complication and syphilis of the lungs as evidenced by the therapeutic test is not rare.

As the eradication of tuberculosis in the future depends upon the prevention of childhood infection, the treatment of the Negro is a vital health problem in the South today on account of the fact that his occupation in 50 per cent of cases throws him into intimate contact with children other than his own, thereby affording a double chance to infect childhood.

REFERENCES

(1) Palmer, G. T.: Jour. A. M. A., September 7, 1919.
(2) Adams: Southern M. J., xiii, no. 2.
(3) Fifth annual report, International Health Board.

EXPERIMENTAL LESIONS OF THE LUNGS PRODUCED BY THE INHALATION OF FLUIDS FROM THE NOSE AND THROAT

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In the course of some experiments on absorption from the upper respiratory mucous membrane in rabbits (1), we found that light fluids, such as India ink (a suspension of minute particles of carbon), if allowed to flow into the nose, were very readily inhaled, producing effects in the lungs the quick development and massive character of which, in the absence of any signs of absorption along the cervical or mesenteric route, gave convincing evidence that they were produced by pure inhalation.

This rapidity and massiveness seemed to give the method some advantages in a study of inhalation over the usual methods employing dust or spray, when the effects are produced more gradually, and it is not so easy to rule out absorption by other routes. We therefore performed a series of experiments by this method, in order to compare the effects thus produced with those found especially in pulmonary tuberculosis, and to observe whether there were any analogies which would constitute evidence for or against the importance of infection by inhalation.

The technique was as simple as possible. The rabbit was held, usually on its back, with the nose elevated, and about 1 cc. of India ink or bacterial emulsion allowed to flow into one nostril from a pipette inserted just far enough to insure the fluid entering the nose. In some cases this was done several times, in others only once.

Rabbit 1 was given 1 cc. of India ink on December 17. This was repeated 11 times in the next twenty-five days. Twenty-four hours after the last injection the rabbit was killed and autopsied. There was no discoloration detected in the upper air passages, trachea or cervical lymph nodes. The upper lobes of both lungs were almost entirely black with many black spots irregularly distributed over the rest of the lungs. There was intense blackening of the bronchial nodes. Microscopic sections of the lungs showed carbon in the smaller bronchi and indicated that the blackening of the lungs was lobular in arrangement, the alveoli

being packed with carbon, much of which had been taken up by large phagocytic cells, evidently the alveolar cells of the lungs; and the deeper structural tissue of the lungs also contained many of these cells apparently travelling along the lymphatics.

The appearance of all this pigmentation, its overwhelming quantity, is absolutely distinct from spontaneous anthracosis, which in rabbits is seldom macroscopically visible in the lungs, and if so occurs only as fine stippling, never as masses or blotches. Spontaneous anthracosis of the bronchial nodes is sometimes fairly marked, but never looks perfectly black.

The spleen showed a good deal of carbon microscopically in the sinusoids, and the walls of arteries in the kidney and elsewhere contained traces of it. There was no discoloration of the mesenteric nodes.

Rabbit 2 was given 5 injections of India ink over a period of a week and killed one hour after the last injection. Autopsy showed flecks of ink in the nasal fossae, trachea and bronchi. There was massive blackening of the right upper and left lower lobes of the lungs, and deep discoloration of the bronchial nodes. The spleen contained a moderate amount of finely divided carbon. The cervical and mesenteric nodes were not discolored. Microscopic sections of the lung showed carbon packed in the alveoli, both free and in large mononuclear (alveolar) cells. The behavior of these cells in this instance, as well as their proliferation in acute and tuberculous pneumonia, emphasizes their close relationship to the fixed endothelial cell and the large mononuclear leucocyte. They seem readily to engulf particles which arrive on their surface, and to proliferate under the stimulus, become detached, and either to be cast off in the expectoration or taken up and carried along the course of lymphatic absorption. The cells of the upper respiratory membrane, on the other hand, do not appear to be phagocytic, but rather to throw off foreign particles by means of their secretion.

Rabbit 3 was given one injection of India ink and killed twenty-four hours later. Autopsy showed traces of ink along the respiratory tract, with massive blackening of the upper lobe of the left lung, and moderate spotting of the middle lobe. The rest of the lungs appeared practically free from carbon. The bronchial nodes were moderately discolored. The cervical and mesenteric nodes were negative. Microscopic sections of the lungs gave similar findings to those in rabbits 1 and 2. Sections of the spleen and kidney showed slight traces of carbon.

Rabbit 4 was given about 3 cc. of India ink at one time and killed half an hour later. Autopsy showed much ink in the nose, mouth, pharynx, larynx, oesophagus, trachea and bronchi. The stomach was filled with vegetable material and this was blackened over a radius of about 2 cm. around the oesophageal opening, but there was no discoloration below this sharply defined level in the digestive tract, the remainder even of the stomach contents being free from ink. The lungs showed almost complete blackening of the left upper lobe, and marked blackening of the left lower and right middle lobes. The bronchial nodes showed marked hyperaemia and a moderate amount of carbon scattered through them. The cervical and mesenteric nodes were negative. The presence of carbon all along the inhalation route, with its complete absence in the intestine, completes the proof that the lung findings are due to inhalation.

Rabbit 5 was given 0.5 cc. of an emulsion of human tubercle bacilli in the nose. In this case there was not the slightest, even momentary, disturbance of the respiration. It was killed and autopsied seven weeks later, when it showed no lesions of the respiratory mucous membrane above the lungs. The lungs showed advanced tuberculosis of the right upper and middle lobes with consolidation, and moderately advanced tuberculosis of the bronchial nodes. The cervical nodes, spleen and mesenteric nodes, were all negative both grossly and microscopically.

Rabbit 6 was given 0.75 cc. of an emulsion of tubercle bacilli and killed after seven weeks. The autopsy findings, gross and microscopic, were identical with those in rabbit 5, the tuberculous process being limited to massive infiltration of the upper and middle lobes of the right lung, and moderately advanced lesions of the bronchial nodes.

SUMMARY

Where the time conditions permitted, the injected material was found all along the respiratory tract to the terminal bronchi and the alveoli. There was never evidence of lesions of the digestive or upper respiratory tract, nor of absorption from them by the mesenteric or cervical lymphatics. The lung findings were no less striking when the animal was killed before the injection had gone further in the digestive tract than the cardiac end of the stomach. Comparatively little of the injected materials penetrated the circulation beyond the lungs and their lymph nodes; not enough, in the case of the tubercle bacilli, to cause any lesions elsewhere in seven weeks. In five of the six animals the maximum effect

was produced in one upper (apical) lobe, in the sixth case in both upper lobes, while in only two cases was there an equivalent effect in a middle lobe, and in only one case in a lower lobe.

DISCUSSION

As has been noted before (1), owing to the complexities of resistance, the distribution of tuberculous or other infectious lesions may not, and in fact does not, give a complete map of the route of absorption. We need only note the absence of tuberculous lesions in locations (for example the spleen) which the presence of carbon proves to be reached by absorbed substances. This is what makes it necessary to check inoculation experiments with India ink experiments, as we are practically certain from many previous tests (1) (2) that the carbon is retained to some extent in all lymphoid structures along the route of absorption. Thus the absence of carbon from the mesenteric nodes, and in one instance its complete absence from the digestive tract below the cardia, its presence in the bronchi, and in massive quantities in the lungs, and the perfect analogy between these findings and the distribution of tuberculous lesions when bacillary emulsion was used, form a firmly linked chain of evidence to prove that the lung findings in all cases are due to pure uncomplicated inhalation.

The only weakness in the argument depends upon the old and so far unanswerable question—Can bacteria be taken up where carbon particles of the same or smaller size cannot, that is, from an absolutely intact mucous membrane? Our conclusion from these and previously reported experiments is that they cannot—that the only bacteria which penetrate these surfaces are those which are capable of actively invading and producing lesions in them, and that even these microörganisms may perhaps require some mechanical or chemical injury to give them a foothold. This however is obviously a matter of opinion, since it is impossible to prove the absolute integrity of a mucous membrane. The strongest evidence we can offer is the failure to find tuberculous lesions in the cervical and mesenteric nodes, in view of the known susceptibility of lymphoid tissue.

Granted that the route of absorption in these experiments is the bronchial, as seems certain, we have here a close analogy to pulmonary anthracosis and infection by inhalation in man. For giving the substance to be inhaled in a fluid form, in animals whose rapid breathing

and comparatively inefficient larynx causes them to spray their own lungs with any light fluid that is in their upper air passages, is only a convenient and rapid way of producing the same effect which we get by inhaling "droplets"—already a fluid suspension of bacteria—or even dry dust, since its absorbable components, carbon and bacteria, must become suspended in the moisture of the respiratory epithelium before they can be absorbed.

The analogy being so close, except in point of time and quantity, between this experimental inhalation and the inhalation to which we are all exposed, the similarity of the experimental results to the findings in human pulmonary tuberculosis becomes of considerable interest. The preponderance of lesions in the upper part of the lung, and in one lung in preference to the other, and the marked involvement of bronchial nodes and absence or inconspicuousness of lesions elsewhere in the body are striking resemblances, and constitute evidence of some value in favor of the importance of inhalation infection in human tuberculosis.

CONCLUSION

By allowing rabbits to inhale suspensions of carbon or of tubercle bacilli from their upper air passages, pigmentations or tuberculous lesions are produced which correspond very closely in distribution to the lesions of pulmonary tuberculosis in man.

REFERENCE

(1) Mullin, W. V., and Ryder, C. T.: Studies on the lymph drainage of the upper air passages and accessory sinuses. Laryngoscope, in press.

(2) Mullin, W. V.: The lymph drainage of the accessory nasal sinuses. Trans. Amer. Laryng., Rhin., & Otol. Soc., 1919.

THE RELATIVE INFLUENCE OF THE CONSTITUTIONAL FACTOR IN THE ETIOLOGY OF TUBERCULOSIS[1]

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I. THE PROBLEM

The problem to which attention is directed in this paper is that of the etiology of clinically active tuberculosis. A few deny the existence of any such problem. Happy in that superlative self-esteem vouchsafed in full measure only to ardent worshippers at the shrine of *idola fori*, they would, if they could, stop all true research on the problems of tuberculosis, and give countenance only to such so called investigative activities as are guaranteed beforehand not to run counter in any particular to the plentiful exhibition of their special brand of eye-water, blatantly touted as the only true panacea for the ills tuberculosis engenders. Fortunately, all scientific students of tuberculosis realize keenly that the problem of the etiology of the disease is a real and important one. The case cannot be better put than it is in a recent paper by Lawrason Brown and his associates (1) where they say, "Our hope in publishing these experiments is that others may realize that the etiology of tuberculosis is not a closed book, but one that contains many disconcerting and confused pages that need to be rewritten."

The problem may with some precision be defined by a statement of the following well-known and thoroughly established facts:

1. Very few, if any, persons escape infection with tubercle bacilli at some time in their lives, especially if they live in large industrial cities. Fishberg (2), after reviewing the literature on the subject says, "No matter what the cause of death may have been, whether the persons knew that they had been tuberculous or not, between 50 and 100 per cent of people living in large cities show active, quiescent or healed tuberculous lesions in some organs of their bodies."

[1] Papers from the Department of Biometry and Vital Statistics of the School of Hygiene and Public Health of the Johns Hopkins University, No. 20.

This paper was read before the North Atlantic Tuberculosis Conference at Richmond, Va., October 7, 1920, in a symposium on the general topic "The Basic Cause of Breakdown with Tuberculosis."

2. A much smaller number of persons than are known and can be proved to have been at some time or other infected with tubercle bacilli ever develop clinically recognizable tuberculosis.

3. Of the two moieties of the infected, those on the one hand who do, and those on the other hand who do not develop the disease in clinically active form, many can be readily shown to have lived under essentially or statistically the same environmental circumstances.

4. What factors determine the group into which a *particular* infected person shall fall, and what is the quantitative influence of each particular possible factor in making this determination?

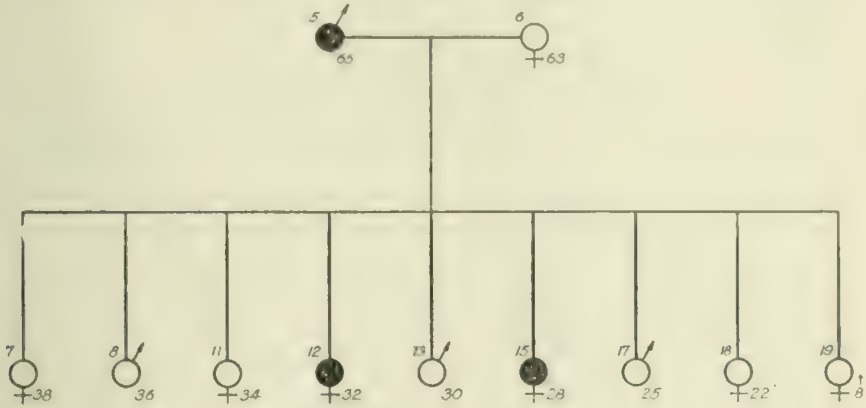

FIG. 1. PEDIGREE CHART OF A TUBERCULOUS FAMILY

Where the body of the sex sign is solid the person has tuberculosis of the lungs; where it is open the person is not tuberculous. The numbers to the right of the bottom of each sex sign indicate the present age, or age at death of the person indicated. The numbers to the left of the top of the sex signs are the designating numbers (in lieu of names) of the indicated persons. + denotes that the person is dead.

This I conceive to be the fundamental and essential problem of the etiology of clinically active tuberculosis.

The problem can be still more precisely visualized by the consideration of a particular family taken from one of the pedigrees worked up in my laboratory.

The time relations of contact of the children in the tuberculous family, whose pedigree is given in figure 1, with their tuberculous father, and with each other, are given in summary form in table 1.

The essential facts regarding this family are as follows: The father, individual no. 5, is a laboring man who has always been addicted to the

use of alcohol in considerable quantities. In 1886, when he was thirty-two years old, he developed clinically active pulmonary tuberculosis and had frequent hemorrhages. He was in this condition when child no. 12, was born. The firstborn daughter, no. 7, has always been at home with the family down to the present time, having thus lived thirty-three years in close contact with an active case. She is by occupation a seamstress. She has never developed any indications of tuberculosis. The first son, individual no. 8, was born in 1883 and lived at home in the same household with his father until he was twenty-eight years old (twenty-five years familial contact). He has never developed any symptoms of tuberculosis. The next child, no. 11, was born in 1885 and lived

TABLE 1

Contact relations involving individuals in pedigree chart

INDIVIDUAL NUMBER	BORN	BECAME TUBERCULOUS	YEARS LIVED IN CLOSE CONTACT IN SAME HOUSEHOLD WITH CASES BEFORE OR WITHOUT ACQUIRING TUBERCULOSIS
5	1854	1886	
6	1856		33
7	1881		33
8	1883		25
11	1885		20
12	1887	1913	26
13	1889		25
16	1891	1912	21
17	1894		24
18	1897		22
19	1880		8

at home with the family, in daily close contact with her tuberculous father for twenty years. She has never developed any symptoms of tuberculosis. The next child was born in 1887. In 1913, when she was twenty-six years old, she developed clinically active pulmonary tuberculosis after having lived twenty-six years in the same household and in close contact with her tuberculous father. Individual 13 was born in 1889 and lived for the first twenty-five years of his life in the same household with the tuberculous father. He has never shown any symptoms of tuberculosis. Individual no. 16 was born in 1891, and in 1912, when she was twenty-one years old, developed clinically active pulmonary tuberculosis. She had lived all this time, and still does, in the same family with her father. Individual no. 17 was born in 1894 and has

always lived with the family until he was drafted and went into the American Expeditionary Force and to France. Since his discharge he is again living with the family. He has never developed any symptoms of tuberculosis, although he has lived for roughly twenty-four years of his life in close daily contact with his father, and also with his two sisters, since the time when they became tuberculous. Individual no. 18 was born in 1897 and has always lived in the same household with her father and the rest of the family. She is now twenty-two years old and thus has had close intimate household contact for twenty-two years with active tuberculous patients. Individual no. 19 was born in 1880, and died when eight years old, probably of acute nephritis, but certainly not of tuberculosis. Individual no. 6, consort of the tuberculous father, has lived in close and intimate household contact with him for the thirty-three years since he first gave evidence of clinically active tuberculosis. She has never shown any symptoms of any tuberculous disease.

Putting all the facts in regard to this family together what do we see? Out of eight living children, all of whom lived together in the same environment, and had the same food, for twenty or more years, two have developed clinically active tuberculosis, while the other six have shown no signs whatever of the disease. All have been in close and intimate personal family contact with their father, who has, as our careful investigation of the family life and medical history indicates, been an open tuberculous patient during the major portion of that time, unable to do any work for most of the time, with hemorrhages recurring at irregular but fairly frequent intervals. Furthermore, individuals nos. 12, 16, and 18 have for many years slept together in the same room. Nos. 12 and 16 have been tuberculous for six and seven years respectively, while 18 has never shown any symptoms of the disease.

It is to be presumed that every member of this family was long ago infected with tubercle bacilli. If we attribute breakdown to poor diet, or to bad housing conditions, it is difficult to see why the disease should have flared up in clinically active form in only two out of eight children who have lived in this same environment throughout the period. All have been subjected to substantially the same degree of environmental and economic pressure. They have all had to work hard, because the father has contributed very little to the support of the family in all these years.

Such a case as this, which could be duplicated over and over from our family records, throws into sharp relief what I conceive to be the essen-

tial problem of the etiology of tuberculosis. Out of an equally infected group of individuals, equally in close contact with active and open tuberculosis, and living under identical environmental conditions, some individuals in the group develop clinically active tuberculosis while others never do. What is the reason for the differentiation? This is the kernel, as it seems to me, of the problem of the etiology of tuberculosis.

The investigation on which this family pedigree which we have been discussing is based was made in 1919. It may be objected that all of the children, 7, 8, 11, 13, 17, and 18, will presently develop tuberculosis and die of it. No one can assert, of course, that this will not happen because it is an event which belongs in the future. I conceive it to be improbable, however, that such an event will occur. The force of untoward environmental pressure on these individuals during the past twenty years has been about as great as it could be, and certainly greater than it is likely to be in the future.

Another objection which might be conceivably raised to the illustration is that neither individual 5, 12, nor 16 has tuberculosis. The answer to this is that they have repeatedly had diagnosis and treatment of the disease in sanatoria and dispensaries. If they are not victims of the disease no one is.

I wish it to be quite clearly understood that this pedigree is introduced here only as an illustration of the problem, and not in any sense, taken by itself, as evidence of the influence of the hereditary factor in the etiology of the disease. It obviously suggests such a factor, but suggestion and demonstration are usually a long way apart. It does illustrate with great clearness and precision the nature of the problem facing one who would account for the etiology of clinically active tuberculosis.

II. HOW SHALL THE PROBLEM BE ATTACKED?

It is obvious on purely *a priori* grounds that in a broad sense the cause of the outbreak of clinically active tuberculosis in one moiety of a group of infected individuals and not in the other moiety must fall into one of the three following categories:

1. Environmental. There are significant differences in the environmental forces, using the term in the broadest sense to include biological as well as physical environment, impinging upon the two moieties, these differences being of sufficient magnitude alone to determine the observed difference in susceptibility to tuberculosis.

2. Constitutional. There are significant differences, of a germinal, hereditary character, in the innate biological constitutions of the individuals composing the two groups, and these differences alone determine the differentiation in respect of outbreak of active tuberculosis.

3. Both. The two groups differ in both environmental and constitutional respects, neither factor alone being ordinarily determinative of tuberculous breakdown.

The first of the enumerated views is the popular one. It opens large possibilities for altruistic enterprise. I judge from what I hear and read that there are still extant naïve individuals who quite honestly believe that if everyone could be induced and enabled to drink two quarts of milk a day and sleep with his windows open, tuberculosis—certainly pulmonary tuberculosis—would disappear from the face of the earth by the middle of next June at the very latest. If only these good souls were right, how happy we all should be!

The second view is extremely unpopular. Any doctrine which implies that the constitutional weaknesses, whether patent or hidden, of the father might be visited upon the sons stirs up no furious enthusiasm in this day and age. The person who has, or had, a number of tuberculous near relatives finds himself particularly antipathetic to this view. If indulged in, what becomes of one's hope in the two quarts of milk or the open window?

The relative popularity of a viewpoint happily has nothing to do with its validity. Extremists in any direction are usually wrong. It is altogether improbable that either environment or hereditary constitution *alone* determines the differential incidence of active tuberculosis. It is much more likely that always both factors are involved. The task is, as I conceive it, not to answer the question "Is it environment?" or "Is it heredity?" but rather to measure, with the greatest attainable precision the relative influence of each factor in determining the result.

In earlier days constitution was generally regarded by medical men as playing a very important rôle in the etiology of tuberculosis. The most comprehensive and critical discussion of the older literature on this point has been furnished by Bulloch and Greenwood (3).

There are only a few chief lines yet thought of by which one can get quantitative evidence as to the relative importance of the hereditary factor in the etiology of tuberculosis. We may direct our attention briefly to some of these different lines of evidence, it being understood, of course, that in the limitations of space which are imposed upon this

paper, it will be impossible to deal with the matter in more than the most sketchy fashion. In other words, what we shall try to do is to present something about the *kinds* of evidence, rather than the amount of each kind which may be brought to bear in any consideration of the problem.

1. Direct evidence as to the inheritance of the tuberculous diathesis. Here substantially the only studies up to the present time which are deserving of serious scientific consideration are those made in Pearson's (4) laboratory, or under his direction. Pearson has attacked the problem of the relative influence of heredity and environment in the etiology of tuberculosis from a number of different angles. In this section we shall consider only one, namely, that side of his work in which he attempts to measure directly the degree of inheritance of the tuberculous

TABLE 2

Coefficients of correlation between parent and offspring

CHARACTER		CORRELATION	AUTHORITY	DATA
Physical	Stature	0.51	Pearson and Lee	Pearson's F. R.
	Span	0.46	Pearson and Lee	Pearson's F. R.
	Forearm	0.42	Pearson and Lee	Pearson's F. R.
	Eye color	0.50	Pearson	Galton's F. R.
Pathological	Deaf-mutism	0.54	Schuster	Dr. Fay's
	Insanity	0.53	Heron	Dr. Urquhart's
	Insanity	0.47	Goring	Convict prisons
	Phthisis	0.50	Pearson	Dr. Rivers's
	Phthisis	0.50	Goring	Convict prisons

diathesis from parent to offspring. This is done by the method of correlation. The coefficient of correlation between parent and offspring in respect of presence or absence of pulmonary tuberculosis is determined by well-known methods, and it is assumed that the correlation which is found is due to inheritance. Unfortunately, the series dealt with were not as large as would be desirable from a statistical standpoint. The general results attained by Pearson for the correlation between parent and offspring in respect to existence of pulmonary tuberculosis are shown in table 2.

From this table it will be seen that, on the face of the facts, the indication is that the tuberculous diathesis is inherited in about the same degree from parent to offspring as such physical characters as stature, forearm length, eye-color, etc. The contention of the environmentalists

and infectionists, however, upon the appearance of these results, was at once that such correlations might well arise solely by familial infection, rather than true inheritance.

Pearson has attempted in a number of ingenious ways to meet this point. Whether one considers that he has successfully done so or not depends, one gathers from the literature, upon the nature and degree of one's prior prejudices in the matter. It will, however, pay us to look at a few of the facts which Pearson has brought forth. If the explanation of the observed correlation between parent and offspring in respect of tuberculosis is familial infection rather than similarity of biological constitution, then it would seem obvious that the correlation between husband and wife in respect of tuberculosis ought to be of something approaching the same order of magnitude as that shown for parent and offspring. If the reason why a tuberculous man's children have tuberculosis in greater proportion than the disease occurs in the general population, is because he has infected them as a result of close familial contact, by the same token his wife ought to be tuberculous. The only quantitative difference, which might possibly be expected, would be such as arose from the fact that when a consort came in contact with the familial tuberculous infection, he or she would be at a more advanced age. It might be contended that at such age the individual would perhaps be better able to resist such infection than the children born in the family and subjected to this immediate and massive source of infection from the earliest ages. Leaving aside any attempt at explanation, the fact is that the resemblance between husband and wife in respect of tuberculosis is as follows (quoting from Pearson):

		Coefficient of correlation
Husband and Wife	All poor	−0.01
Husband and Wife	Prosperous poor	+0.16
Husband and Wife (Pearson)	Middle classes	+0.24
Husband and Wife (Dr. Williams)	Professional classes	+0.28

It would thus appear, either that like mates with like more commonly in the more intellectual classes, or that infection is more likely to occur in middle class than in poor households. I think there is not the least doubt that much of the relatively small resemblance of husband to wife in the matter of phthisis is due to a selective influence and not to infection at all. This selection is largely an intellectual one and has no existence among the very poor.

Pearson went on to show from his family records, leaving entirely out of account the husbands and wives themselves, and determining the

degree of assortative mating between tuberculous *stocks*, that the correlation worked out to 0.30, as high as in the extreme cases of mating with regard to pulmonary tuberculosis.

Now if we compare the correlation coefficients for parent and offspring as shown in table 2, with those for husband and wife just given, it would indicate that the parent is twice as dangerous to the offspring, if the source of the resemblance is familial infection, as the husband is to the wife. This, of course, common sense tells us is a highly improbable result. It tends to indicate that neither correlation is primarily to be explained on the basis of infection, but that the one is due to inheritance of the diathesis, and the other to assortative mating of tuberculous stocks.

The whole case, however, leaves one with the feeling that so far as the direct measurement of inheritance is concerned, we need more and better evidence than that which has been furnished by Pearson. We need, in the first place, more critically accurate original data, in which we shall have exact and direct information, in so far as it is possible to get it, obtained by trained field workers in the families, regarding such points as degree and duration of familial contact with open cases, as well as the more usual points upon which data are taken. At the same time, we need equally critical data from nontuberculous families collected in the same way by field workers in the families. Again it is not entirely clear from a methodological viewpoint that the correlation method is a sound one, taken by itself alone, for the measurement of the intensity of inheritance. The results got in this way need confirmation by some independent method of analysis before they can be unreservedly accepted at their face value. Pearson's was pioneer work, and it unquestionably strongly indicates that the hereditary factor is a highly important one in this disease. Only the reckless environmental fanatics will be disposed to neglect it, or to regard it as wholly worthless. The problem to be solved is, however, one of such vast importance to the human race, that before any sweeping conclusions are drawn on which administrative action is likely to be based, it is essential that much further investigation of the problem be made. Furthermore, any statistical or family history evidence on the subject should be checked and verified by direct experimental evidence in the laboratory, obtained from breeding operations with lower animals, as to the inheritance factor in the etiology of tuberculosis. It is a great satisfaction to know that investigations of this kind are now in progress. Their results will be eagerly awaited by all students of the problem.

In order to illustrate directly some of the difficulties which inhere in any attempt to make a thorough scientific investigation of the problem of the inheritance of the tuberculous diathesis in man, I should like to speak briefly about some of the work going on in my own laboratory. About a year and a half ago plans for a comprehensive and searching investigation of the problem of the etiology of clinically active tuberculosis were embarked upon.[2] While it was contemplated that the problem would be approached from many angles, and this is in fact being done, I wish to speak now of one phase of the work, namely, that which has to do with the obtaining and analyzing of data directly bearing upon the problem of inheritance of the diathesis. The plan of the work was to make a thorough study of the family histories of individuals afflicted with tuberculosis, and of individuals free from tuberculosis, both sets of individuals being taken from the same economic and social strata. "Family history" in this connection is used in the broadest possible sense to include not only information as to relatives direct and collateral, but also as many pertinent data as possible about the individual life histories and habits of these individuals.

The work is in far too early a stage now to make any statement of results whatever, nor do I care at this time to go into any discussion of the details about either the comprehensiveness or the thoroughness of the records which we are accumulating. I may merely say in passing that, so far as I am acquainted with the facts, I know of no data for the study of the etiology of this or any other disease which begin to approach these in respect of either comprehensiveness, detail, or accuracy. Our ideals in these respects are set very high, and in consequence a number of years must still elapse before a sufficient amount of material can have been collected for the kind of analysis which must be made. Here I wish to use a little of the material, only for the purpose of illustrating the difficulties which beset research upon this problem.

If heredity is a factor of importance in the etiology of clinically active tuberculosis it would be reasonable to expect that a tuberculous individual would have a larger proportion of his or her blood relatives, both direct and collateral, and in ascending and descending generations from the individual, than would a person who was not tuberculous. Or, to put the matter in another way, suppose we stopped the first man or woman we chance to meet on the street and ascertained by appropriate

[2] During the past year this investigation has been supported by a grant from the National Tuberculosis Association.

methods whether that person was or was not tuberculous, and at the same time made detailed inquiries as to his or her blood relatives. Should we be justified in laying a wager, if the individual proves to be tuberculous, that a larger percentage of his relatives will be also tuberculous than if he himself were nontuberculous, and what if any odds could we give in such a wager? In table 3 I have collected together the data on this point from 57 family histories which we have been able to

TABLE 3

Showing the frequency of occurrence of tuberculosis among the blood relatives of (a) tuberculous persons and (b) nontuberculous persons

(Figures based upon the family histories of 38 tuberculous and 19 nontuberculous subjects)

GENERATION AND GROUP RELATIVE TO SUBJECT OF HISTORY	NUMBER OF BLOOD RELATIVES WHO ARE			PER CENT TUBERCULOUS
	1. Tuberculous	2. Nontuberculous	Total	
Same generation				
a. Tuberculous subject	96	876	972	9.9
b. Nontuberculous subject	5	979	984	0.5
Parental generation				
a. Tuberculous subject	42	430	472	8.9
b. Nontuberculous subject	14	749	763	1.8
Grandparental generation				
a. Tuberculous subject	7	236	243	2.9
b. Nontuberculous subject	8	298	306	2.6
Great grandparental generation				
a. Tuberculous subject	3	30	33	9.1
b. Nontuberculous subject	1	86	87	1.1
Child generation				
a. Tuberculous subject	43	972	1015	4.2
b. Nontuberculous subject	0	212	212	0.0
All generations				
a. Tuberculous subject	191	2544	2735	7.0
b. Nontuberculous subject	28	2324	2352	1.2

complete to date, involving something over 5000 blood relatives of the 57 subjects of these family histories. Of these subjects, from each of which a detailed history starts, 38 are tuberculous, and 19 are nontuberculous. Each group may be regarded as a random sample of the working class population of Baltimore, the only differential factor in the selection being that in the one case the individual with whom a history started was tuberculous, and in the other case not.

Five generations are included in the table. There are: First, the generation to which the subject of the inquiry himself belongs: this is the generation in which his blood relations are brothers, sisters, or cousins; second, the parental generation, that is, the generation to which the subject's father and mother, and his uncles and aunts belong; third, the grandparental generation; and fourth, the great grandparental generation. The "child generation" is the generation to which the subject's children, and his nephews and nieces belong. Relatives by marriage solely, of course, are not included. Only those persons are included who have a biological or "blood" kinship to the subject in some degree or other. But all *degrees* of kinship, collateral and direct, near and remote, are included.

The net result is striking. Taking all the generations together we see that in these statistics a tuberculous person has 7 per cent of his or her blood relatives tuberculous, whereas a nontuberculous person, chosen at random, has only 1.2 per cent of his or her blood relatives tuberculous, the absolute numbers involved in the two samples being approximately the same. In other words, in so far as this material may be regarded as typical, we can assert that a tuberculous person chosen at random from the working class population will have nearly six times as many blood relatives tuberculous as will a nontuberculous person taken at random from the same population. We note that the same kind of difference appears in each generation. The difference is insignificantly small in amount in the grandparental generation. This must be attributed, I think, merely to random sampling. I judge that with larger numbers, this generation would pass into the same class as the others.

One other point which needs explanation, lest an erroneous conclusion be inadvertently drawn from table 3, appears in the figures for the child generation. It will be noticed that whereas the histories of the 38 tuberculous subjects yield 1015 blood relatives in the child generation (F_1 generation in current genetic usage) the 19 histories of nontuberculous subjects yield but 212 individuals in the same generation. This does *not* mean, as might be supposed, a reduced fertility in the nontuberculous as compared with the tuberculous. The difference arises merely from the fact that the method of selection of subjects upon which to start histories is such as to give a considerably lower average age of *subject* in the nontuberculous group. Naturally they would have fewer offspring in the F_1 generation. Briefly the method of getting cases is this: Tuberculous subjects are taken at random from the list of active

cases registered in the Tuberculosis Bureau of the Baltimore Health Department. Nontuberculous subjects are taken at random from cases which have passed through the Juvenile Court of Baltimore at one time or another. The individuals are naturally, on the average, younger in the latter case than in the former.

An inexperienced person, not aware of the pitfalls which strew the pathway of the investigator of tuberculosis might think that table 3 told the whole story; that it in short proved the case for the inheritance of the disease. But it will pay us to look a little further into the matter before jumping to this alluring conclusion. Amongst other data which we have collected in this work we have included elaborate and detailed information wherever possible as to the duration and extent of personal contact of individuals in the family history with persons in an active "open" tuberculous condition, whether in the family home or outside. Of course it is impossible to get this information accurately for every individual in a pedigree, and consequently the number of individuals appearing in the following tables is smaller than in table 3. Let us examine the data obtained from such inquiries. The material is exhibited in tables 4 and 5. In this table the headings have the following meanings:

1. *Close contact* means that the enumerated offspring, whether tuberculous or not, were *known* to have been in close and frequent contact with an active case or cases of tuberculosis in their relatives or elsewhere. In case of the tuberculous offspring this contact existed for some time *before* they, the offspring, became themselves tuberculous.

2. *No close contact* means that the enumerated offspring, whether tuberculous or not, were known *not* to have been in close and frequent contact with an active case of tuberculosis among their relatives, and there is no evidence that they were in such contact with active cases among other persons.

Table 4 gives the raw material so far available.

The data of table 4 are summarized in percentage form in table 5. Inasmuch as the number of cases for some of the ancestral combinations is small, we have ventured to combine certain of the rubrics of table 4. It will be noted that even in this small beginning of the contemplated investigation we have included in table 4, 690 individuals for whom we know the contact relations and the tuberculous history of the ancestry for two generations back.

These results are a striking illustration of the caution which must be exercised in drawing conclusions about the inheritance factor in the etiology of tuberculosis. We note:

1. Where there is no immediate tuberculous ancestry (parents and grandparents nontuberculous) 7.4 per cent of the offspring are actively tuberculous. This probably represents a little less than the normal incidence rate of the disease in the general working class population in Baltimore. Of this 7.4 per cent, however, nearly a fourth (exactly 22.2

TABLE 4

Contact relations of individuals in family histories

ANCESTRY	OFFSPRING							
	Nontuberculous		Tuberculous		Suspect		Total	
	Close contact	No close contact	Close contact	No close contact	Close contact	No close contact	Close contact	No close contact
No parent or grandparent tuberculous	38	300	5	21	1	0	44	321
No parent, one grandparent tuberculous	16	65	5	10	2	0	23	75
One parent, no grandparent tuberculous	46	13	15	1	10	0	71	14
One parent, one grandparent tuberculous	43	19	5	1	0	0	48	20
One parent, two grandparents tuberculous	11	4	2	0	0	0	13	4
One parent, three grandparents tuberculous	2	0	0	0	0	0	2	0
Two parents, no grandparent tuberculous	20	5	13	1	3	0	36	6
Two parents, one grandparent tuberculous	6	3	4	0	0	0	10	3
Totals	182	409	49	34	16	0	247	443

TABLE 5

Percentage of close contact in different ancestral groups

ANCESTRY	PER CENT OF TOTAL OFFSPRING TUBERCULOUS	PER CENT OF TUBERCULOUS OFFSPRING IN CLOSE CONTACT	PER CENT OF NONTUBERCULOUS OFFSPRING IN CLOSE CONTACT
No parent or grandparent tuberculous	7.4	22.2	11.2
No parent, one or more grandparents tuberculous	17.3	41.2	19.8
One parent, and no, one or more grandparents tuberculous	19.8	94.1	73.9
Two parents, and no, or one grandparent tuberculous	38.2	95.2	76.5

per cent) were known to have lived for some time before developing the disease in close contact with an active case or cases of tuberculosis. On the other hand, of the 92.6 per cent of nontuberculous offspring of nontuberculous ancestry only about one-tenth (exactly 11.2 per cent) had been in close contact with an active case. In other words, twice as many of the tuberculous offspring of nontuberculous ancestry had been

in close contact with active, open tuberculosis, as had been the case with the nontuberculous offspring of nontuberculous ancestry.

2. As we pass to the next ancestral rubric, which includes cases where neither parent was tuberculous, but one or more of the grandparents were, it is seen that the percentages all increase. Seventeen and three-tenths of the offspring are tuberculous, but nearly one-half of these tuberculous offspring (exactly 41.2 per cent) were for some time before acquiring the disease in close and intimate contact with an active open case or cases. In the case of the 58.8 per cent of nontuberculous offspring, having the same type of ancestry relative to tuberculosis, only about one-fifth (actually, 19.18 per cent) had been in such close contact with active open cases. Or again we see, just as in the nontuberculous ancestry rubric, that relatively about twice as many of the offspring who developed clinically active tuberculosis had been in close contact with other tuberculous cases as in the case of the non-tuberculous offspring of the same type of ancestry.

3. The next line of the table includes the cases of still more pronounced tuberculous ancestry. Here are brought together all of the offspring who had one parent tuberculous, and no, one, or more grandparents tuberculous. In this case, the percentage of the total tuberculous offspring rises only a little above that in the preceding rubric, the increase amounting to only 2.5 per cent, but the contact rates show a relatively enormous difference. Whereas, about one-fifth of the offspring of this type of ancestry themselves show active tuberculosis, nearly all of the individuals who do exhibit the disease (exactly 94.1 per cent) are known to have been in close contact with one or more clinically active cases for some time before they broke down with the disease. Of course, this enormous increase in the percentage is accounted for, to a large degree, by the fact that one parent is tuberculous, and the children have lived with this parent while he or she was actively tuberculous, but before they (the children) acquired the disease. But whatever the explanation the difficulty in interpreting the data from the standpoint of pure inheritance is obvious. An exactly similar, though not so large, increase is found when we examine the nontuberculous offspring of this same type of ancestry, where one parent, and no, one, or more grandparents are tuberculous. Of the nontuberculous offspring of such ancestry 73.9 per cent have been in close contact for some time with active open cases of tuberculosis.

4. In the last line of the table we have the cases where both parents, and no or one grandparent were tuberculous. Here we find 38.2 per cent of the offspring tuberculous. Of these tuberculous individuals, 95.2 per cent were known to have been for some time in close contact with an active open case or cases of tuberculosis before they exhibited signs of

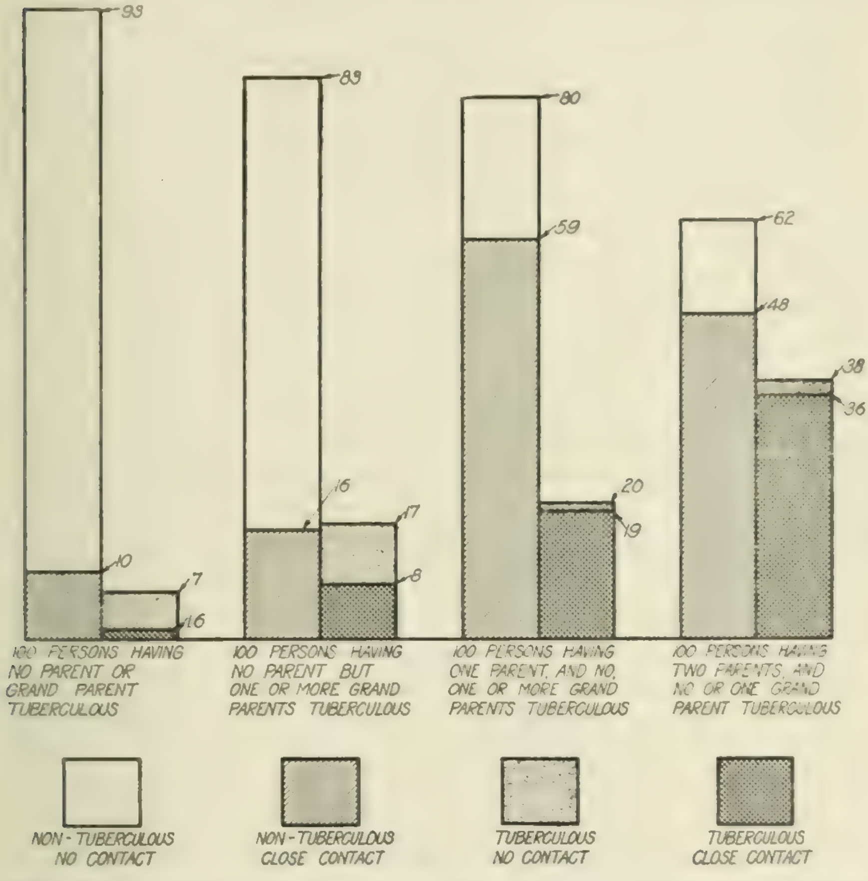

FIG. 2. SHOWING THE CONTACT RELATIONS OF TUBERCULOUS AND NONTUBERCULOUS INDIVIDUALS OF DIFFERENT GRADES OF TUBERCULOUS ANCESTRY, PREPARED FROM DATA OF TABLES 4 AND 5

the disease. Of the 51.8 per cent nontuberculous offspring of this same ancestry, about three-fourths (exactly 76.5 per cent) had been in close contact with active open cases to just as great a degree as their tuberculous brothers and sisters without themselves developing the disease.

The results of table 5 are shown graphically in figure 2.

These tables, 4 and 5, demonstrate the difficulty of interpretation which inheres in statistics regarding the inheritance of the tuberculous diathesis. As the amount of tuberculosis in the direct ancestry increases, the amount of tuberculosis in the offspring increases also, but the disturbing fact is that the rate of close contact with open active cases increases enormously more rapidly than does the rate of incidence. In short, we find that where one or both parents are actively tuberculous, practically all the offspring who subsequently develop tuberculosis have been in close, intimate contact with another active case, usually, of course, that of the parent or parents. Instantly those who oppose the view that constitution plays any part in the etiology of disease, and particularly of tuberculosis, will assert that this explains the whole matter—that if the children had not been in contact with the open, active cases, they would not have broken down with the disease. Just possibly they may be right. The case, however, is not simple. Our figures equally show that where one or both of the parents were actively tuberculous, *virtually three-fourths of the nontuberculous offspring have been in just as close contact with active open cases as their brothers and sisters who unfortunately developed the disease.* And it must not be supposed that this high contact percentage can be explained by asserting that the nontuberculous children of tables 4 and 5 are all young children who will subsequently all develop the disease. This is not true. Their average age is significantly the same as that of the tuberculous offspring.

Since the material is here used for purposes of illustration only, and since the numbers involved must be greatly increased before a final analysis can be undertaken, I shall make no attempt here to go into any further detailed analysis of this material along lines which obviously suggest themselves. The disturbing thing, and the thing which demonstrates that much further work must be done upon the problem, is that in every case the close contact rate is higher (compare the second with the third column in the table) for the tuberculous offspring than it is for the nontuberculous offspring. In other words, these figures indicate that familial contact with active open cases is beyond question a factor in determining the incidence rate of clinically active tuberculosis. It appears equally obvious, however, that it certainly does not account for the whole, and probably accounts only for a small part, of the increase in the incidence of the disease which we find to occur as the amount of tuberculosis in the immediate direct ancestry increases.

As I have repeatedly stated, these figures are to be regarded as only preliminary, and are introduced here solely for illustration of difficulties of method. Before we shall be satisfied to draw conclusions from them, or to pursue them to their ultimate possibilities in the way of mathematical analysis, we shall need to multiply the numbers many-fold. I do think, however, that the material here presented is sufficient in the first place to justify caution against accepting unreservedly any supposed measurements of the force of inheritance in determining the frequency of breakdown from tuberculosis. In the second place, I think the figures are useful as demonstrating that if the problem is ever to be solved we must obtain data of a much more detailed and accurate character than any of those which, so far as I am aware, have hitherto been used, in attempting to measure the significance of the inheritance factor.

Evidence from the natural history of the disease. We may now pass from a consideration of the direct evidence of the inheritance of the tuberculous diathesis to certain of the lines of indirect evidence, which are not less important in reaching a just conclusion regarding this important problem. A good deal of important indirect evidence may be derived from known facts regarding the natural history of the disease. Let us first in this connection examine what is known about the history of mortality from tuberculosis in old civilizations on the one hand, and newly settled countries on the other hand. Pearson was the first to point out the curious fact that the decline in the rate of mortality from tuberculosis, which in old and long settled countries had been going on at a steady rate for a good many years, ceased to proceed at the same rate almost immediately following the discovery of the bacterial causes of the disease. While to be sure the mortality rate continued to decline, this decline has proceeded at a much slower pace since the time of Koch's discovery of the bacillus, and the consequent inauguration of the active "fight against tuberculosis." Pearson first dealt in detail with the corrected mortality rates for England, and compared the phthisis death rate with the general death rate from all causes. He found during the period from 1847 to 1866, which was characterized in the case of the general death rate from all causes by a stability of course, that the death rate from phthisis fell long before the general death rate, and before what may be termed the period of sanitation. He points out that "this in itself indicates a natural rather than an artificial decay of phthisis." He further showed that during what he terms the "period of sanitation" (1866–1891) the fall in the phthisis death rate was more marked than in

the general death rate. During his third or last period (1891–1910), during which time three things happened, namely, the discovery of the tubercle bacillus, the introduction of sanatoria for the treatment of tuberculosis, and the inauguration of the "fight against tuberculosis," the rate of fall in the death rate of phthisis instead of being accelerated was actually retarded.

Examination of the same sort of data from other countries in Europe, and from the part of the United States adjacent to the Atlantic seaboard, where the records run back for a considerable period of years, indicates that these phenomena which Pearson first pointed out for the tuberculosis death rate of England are apparently general and world-wide phenomena, for all biologically similar kinds of population. Owing to lack of space it is impossible to present this material here.

Recently Pearson (5) has brought his discussion of the tuberculosis death rate of England up to date. In 1911 he pointed out that the curves then available seemed to indicate that an actual rise in the phthisis death rate might in the near future be reasonably expected. The indications that this view was correct were still stronger when the returns for 1910 and 1914 were plotted. In the most recent paper he has plotted the figures to and including 1918. Owing to the difficulty in interpreting any vital statistics in a country like England during the war period it is not entirely clear whether the actually observed rise in the rate of tuberculosis mortality which the curves show is to be regarded as a real phenomenon. Pearson's very conservative conclusion in the matter is as follows:

> On the whole it is risky to form a very definite judgment, but, having regard to the female phthisis death-rate and to the percentage of the phthisis death-rate on the general death-rate, war difficulties do not seem to me sufficient to obscure the general trend of our graphs (as indicated before the war), namely that somewhere about 1915 the fall in the phthisis rate which has been less rapid since 1895 would cease altogether and probably be followed by a *rise.* The next five years will show whether this be true or not. We should expect a fall in the phthisis death-rate immediately, but on the average the value will remain higher than that of 1915.

Strong indirect evidence of the importance of the constitutional factor in the etiology of tuberculosis is afforded by the course of the tuberculosis death-rate in newly settled countries, where pioneering stock has gone to take advantage of the opportunities of an unexploited land. The

course of events in all such countries where it is possible to get figures seems to be something like this. In spite of the fact that the early settlers are for the most part within the age groups where the incidence of tuberculosis is normally heaviest, namely, from say twenty to forty-five years, the tuberculosis mortality in these countries is at the outstart very low indeed, and rises, at a more or less rapid rate in different countries, the longer the country has been settled, until finally it reaches what

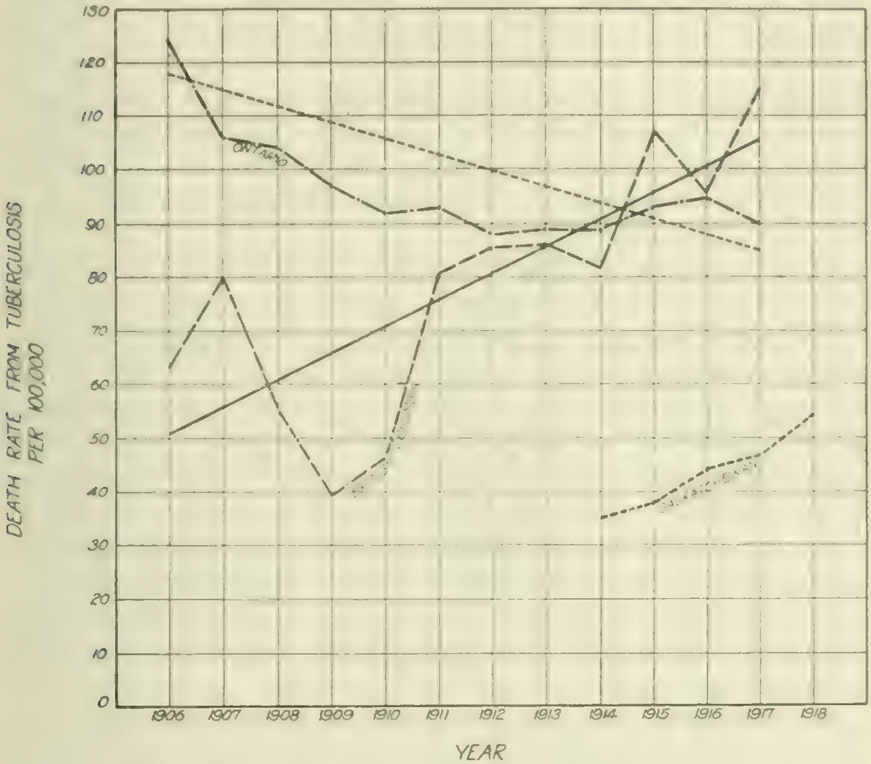

FIG. 3. DIAGRAM SHOWING THE COURSE OF THE DEATH-RATE FROM TUBERCULOSIS IN THE PROVINCES OF BRITISH COLUMBIA, SASKATCHEWAN, AMD ONTARIO, CANADA

may be regarded as a normal level for the tuberculosis death rate, having regard to the climatic conditions and the racial stocks involved, whatever they may be. As an indication of what happens in such cases figure 3 is inserted, which gives the death rate from tuberculosis for the Provinces of British Columbia and of Saskatchewan in the Dominion of Canada. For comparison over the same period of time the tuberculosis death rate of the Province of Ontario is inserted. Ontario is, of course,

a much longer settled country than either Saskatchewan or British Columbia. Unfortunately, the number of years available for either of the new provinces is small, but the curves given will sufficiently indicate the general trend of affairs.

This diagram shows that in the relatively newly settled provinces of British Columbia and Saskatchewan the tuberculosis death rate is rising.[3] In British Columbia, which has been settled longer (it entered the Canadian Confederation in 1871) than Saskatchewan (which became a province in 1905) the rate has reached what may be regarded as a normal level and is not likely to increase much further. On the other hand the rate in Saskatchewan is extremely low *absolutely*, and is rising rapidly. In both cases the contrast with Ontario, which is inhabited by the same sort of people racially as the other two provinces mentioned, is very great. The Ontario rate is slowly falling, the normal condition in an old, long-settled country.

These results are precisely of the sort which would be expected on biological grounds. Pioneering stock—the sort of people who adventure to settle new countries—is made up mainly of constitutionally sound and vigorous people. They are of the age most liable to tuberculosis, but they are constitutionally not the kind of persons who have tuberculosis. Consequently, we find the death rate from tuberculosis in the earlier years of such settlement of new country, very low. But it steadily rises. As the new land is opened up by the pioneers and living is proved by them not to be too hazardous a business, people of weaker stocks follow them into the country. The death rate from tuberculosis in consequence begins to rise and continues steadily to do so till a stable absolute level is reached corresponding to the normal for the climatic conditions and racial stocks involved.

The phenomenon which is here illustrated by the data from these three Canadian provinces appears to be general for new countries as compared with those of long settlement.

Evidence from differential racial incidence in the same environment. It is a well known fact that different races and peoples exhibit statistically widely different rates of mortality from tuberculosis. I do not now refer to any comparison of uncivilized races initially exposed to the tubercle bacillus, with civilized races long habituated to its pres-

[3] In order to show more clearly the trend of the mortality, straight lines have been fitted to two of the curves in fig. 3. The equation to the British Columbia curve is $y = 45.9 + 4.9x$, where y denotes death rate and x time. The Ontario curve is $y = 110.4 - 2.1x$.

TABLE 6

Comparative mortality from pulmonary tuberculosis of different race stocks in New York and Pennsylvania, 1910

SEX AND AGE PERIOD	DEATH RATES PER 100,000 LIVING AT SAME AGES, OF PERSONS BORN IN													
	Austria-Hungary		Russia		Italy		Germany		England, Scotland and Wales		Ireland		United States (Whites only)	
	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York	Pennsylvania	New York
Males:														
All ages	118.0	166.0	107.4	114.7	81.5	112.1	194.9	267.4	150.2	215.2	342.8	589.3	105.1	170.9
Under 10	13.8	16.7	15.4	23.5	19.9	8.3	147.9			23.4			23.3	23.4
10–14	35.5	14.1		11.7	23.0	15.1		52.8		36.9			11.2	10.2
15–19	55.4	102.4	69.6	60.5	43.4	106.8		90.8	120.3	128.7	428.0	312.3	61.1	101.5
20–24	106.5	93.1	99.6	96.4	86.5	140.4	211.3	45.9	59.3	71.5	127.7	327.3	147.6	216.3
25–44	110.6	177.2	105.9	117.1	71.2	102.0	198.2	252.5	151.5	240.5	375.8	662.9	185.2	352.0
45–64	264.2	302.5	225.1	246.4	154.3	172.9	230.3	350.0	165.3	268.9	408.8	682.1	174.1	262.1
65–84	242.7	247.9	148.7	182.4	631.8	208.5	140.6	211.3	233.5	210.3	206.1	329.3	189.3	161.4
85 and over							180.2	210.7				357.6	60.0	69.3
Females:														
All ages	130.2	102.6	91.7	74.6	102.2	160.1	90.4	115.3	133.2	123.3	201.2	276.1	98.8	109.6
Under 10	27.4		31.3		42.0	34.0		51.7	41.6	23.2			19.1	20.6
10–14	17.3	13.7		5.7		89.1						138.1	19.3	27.1
15–19	74.2	49.6	70.9	28.0	102.0	220.6	39.1	76.9	84.4	64.0	63.6	185.6	91.5	111.5
20–24	141.2	87.9	92.6	88.7	153.6	247.7	128.0	158.2	80.4	121.5	121.6	167.7	162.3	186.3
25–44	152.7	137.2	108.0	104.7	114.8	159.3	106.2	125.1	166.9	165.4	235.3	353.4	172.8	193.3
45–64	162.3	122.9	124.6	80.8	77.7	123.3	85.4	109.7	112.2	92.1	220.7	250.1	108.9	111.1
65–84	215.7	142.1	178.7	94.3	217.3	55.4	72.9	106.3	153.7	139.3	140.9	192.1	178.7	137.9
85 and over						793.7	156.7	80.3	314.5	164.5	148.6		100.9	32.6

ence. It is well known that the ravages of this disease, as well as many others, are terrific among people meeting it for the first time. Such facts have little if any evidential bearing upon our present problem. There is, however, another set of facts which appears to be of considerable significance in indicating that genetic constitution plays an important part in the etiology of the disease. This is the widely different rates of fatal breakdown from tuberculosis among different racial stocks living in the same general environment. The most recent data upon the subject are furnished by Dublin and Baker (6) in a notable piece of bio-statistical research.

Table 6 is compiled from their data.

From this table it is evident that different racial stocks, living under the same climatic conditions, exhibit wide differences in their mortality from tuberculosis. Contrast the Italian, with a male mortality at all ages from tuberculosis of 81.5 per 100,000 in Pennsylvania, with that of Irish males in the same state, which reaches the value of 342.8 per 100,000. For the same two race stocks the females show in the same state mortality rates of 102.2 and 201.2 per hundred thousand respectively. It is evident that the Irish react to the same environment in a totally different way than do the Italians in respect of tuberculosis. The relatively great racial susceptibility of the Irish to this disease is well-known. It appears wherever vital statistics are recorded.

There are many interesting points of detail which might be discussed in connection with table 6, but space is lacking here. I merely insert the table as a standing demonstration of the broad general fact that there are wide differences in respect of mortality from tuberculosis among different race stocks living in the same general environment. These differences are larger in amount than can reasonably be explained by any differences which may be supposed to exist, or do in fact exist, between the different stocks in respect of habits of living, social, or economic status, or other environmental factors.

CONCLUSION

In the brief space of an address it is wholly impossible to marshal more than the smallest fraction of the pertinent evidence which bears upon this problem. All that has been attempted here, and if that has been accomplished I am satisfied, is to demonstrate, in the first place, that the problem of the causation of breakdown with clinically active tuber-

culosis, is a problem of tremendous complexity and difficulty, towards the solution of which only the merest beginning has been made, and in the second place, that the inherited constitution of the individual is a factor in the problem of a great deal more than the negligible importance which some in high positions would accord it. I realize as clearly as my critics, potential and actual, possibly can that the evidence which I have presented here, as well as practically all of the other evidence now existing regarding the role of the constitutional factor in tuberculosis, is capable of other interpretation than the one here suggested. I personally think that these other possible interpretations of the facts I have set forth are extremely improbable, and that the one I have suggested is probably the correct one. I cannot as yet, however, *prove* the absolute correctness of my faith. But I also perceive with equal clearness that the environmentalists' case, the infectionists' case, and all the rest are on no better footing. The plain fact is that we are densely ignorant of the relative influence of the several factors which may be concerned in the etiology of tuberculosis. The task before the investigator is to devise and accomplish a real measurement of the relative importance of the hereditary and environmental factors in the tuberculosis problem.

With the closing remarks of Dr. William Bulloch, in the discussion following the reading of the notable paper by himself and Dr. Major Greenwood before the Royal Society of Medicine, I find myself in complete agreement. Doctor Bulloch said that the object in presenting the paper was:

to enter a protest against the wild statements now being made in the lay and medical press, that the whole problem of phthisis was one of infection. Medical history showed that in tuberculosis, as also in the case of other diseases, the most extreme views were taken, not by those who had contributed the actual advancement in knowledge, but by those whose business it was to apply those advancements for the needs of the public. There were a large number of well-ascertained facts which were not entirely explicable on the doctrine that disposition was not an important factor in the genesis of the disease, and that before rigorous measures were applied on a wide scale the actual facts should be ascertained. He did not agree that public health authorities must always "do something." This "doing something" should be put a stop to until there was a reasonable supposition that it was going to achieve its end. He did not wish it to be understood that the tubercle bacillus was not a potent factor. What he did refuse to believe was that it was the only factor. He considered that the disposition, the power of the individual

to resist the aggressive inroads of the bacillus, was greater than many people held at the present day.

Finally, I wish also to quote the closing words of a recent notable paper by Dr. S. Lyle Cummins (7). He says: "These considerations indicate that exhaustive research is still necessary in order that efforts at the control of tuberculosis may be directed upon effective lines." With this opinion I most heartily agree.

REFERENCES

(1) Brown, L., Petroff, S. A., and Pesquera, G.: Etiological studies in tuberculosis. Amer. Rev. Tuberc., 1919, iii, 621.

(2) Fishberg, M.: Pulmonary tuberculosis. Lea & Febiger, Philadelphia and New York, 2nd edition, 1919, p. 58.

(3) Bulloch, W., and Greenwood, M.: The problem of tuberculosis considered from the standpoint of disposition. Proc. Roy. Soc. Med., May, 1911, iv, Epidem. Sect., 147–184.

(4) Pearson, K.: Tuberculosis, heredity and environment. Eugenics Laboratory Lecture Series, 1912, viii. This is a popular summary of the work mentioned on p. 694.

(5) Pearson, K.: The check to the fall in the phthisis death-rate since the discovery of the tubercle bacillus and the adoption of modern treatment. Biometrika, 1919, xii, 374.

(6) Dublin, L. I., and Baker, G. W.: The mortality of race stocks in Pennsylvania and New York, 1910. Quart. Publ. Stat. Assoc., 1920, xvii, 13.

(7) Cummins, S. L.: Tuberculosis in primitive tribes and its bearing on the tuberculosis of civilized communities. Internat. Jour. Pub. Health, 1920, i, 137.

ENVIRONMENTAL FACTORS IN TUBERCULOSIS[1]

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From the Kenneth Dows Fund for the Study of Tuberculosis, of the Medical Clinic of the Johns Hopkins Hospital and University

The topic before the conference to-night is phrased as a query, in the manner of a subject to be debated. It is, moreover, put in such a way as to suggest that somewhere in the shorter or longer journey which the human being traverses between his reception of the tubercle bacillus and his consciousness of the latter's effects, there enters a *single* decisive factor which determines the release of all those baneful effects of the germ to be met with in the man sick with tuberculosis.

I may at once avow, to the prejudice of any argument that may later be necessary to support my views, that my own conception of tuberculosis does not permit so restricted an understanding of its clinical etiology. Basic *causes* of breakdowns I can readily comprehend: *the basic cause*, not at all. For, to imagine the actuality of *the* basic cause, that is, that there is at work a *single* influence which leads and brings tuberculous infection into the open, would make it necessary for me to scrap practically every bit of all that information which to me seems best authenticated and most easily demonstrable under the most rigid conditions of observation available to experimental biologists and clinicians. Before adapting my mind to accept the possibility of one basic cause I should be obliged to give up every fact, as I see it, of pathological evolution, of symptomatology, treatment and of specific immunity in tuberculosis. The clinical etiology of the infection cannot be set apart from several of these other phases and data from all cannot but contribute to an understanding of the etiology. A thorough analysis of these interrelations is neither possible nor in place here. But much that I shall have to say will at bottom concern etiology viewed as an inseparable part of what is a compact whole—from infection at one end to death or healing at the other.

[1] An address delivered at the General Meeting of the North Atlantic Tuberculosis Conference, Richmond, Virginia, October 7, 1920. At this meeting was discussed The Basic Cause of Breakdown with Tuberculosis: Is it Malnutrition, by Bailey B. Burritt, New York; Is it Heredity, by Raymond Pearl, Baltimore, and Is it Environment, by the author.

You will understand, therefore, why special pleading for environment as the basic cause of breakdown appears to me to be futile and unscientific. And, although it settles nothing, I consider it much more to the point to call attention to various factors and perhaps determining conditions which must always be thought of—at least, they cannot be neglected or dismissed off hand—whenever the account of tuberculosis etiology comes to be cast up. These factors, as it happens, may for the most part be comprehended in what we call environment.

But first, what concept shall the term environment convey? Though, in its relation to tuberculosis it is probable that environment will convey to various men an impression of larger or smaller domains, although its scope cannot be strictly defined, and although too there will be no universal agreement as to its scope, for the purpose of exposition it is very necessary to make clear what we mean by environment.

This fact was very strongly borne in upon me several weeks ago while discussing tuberculosis etiology with several men who are in the forefront of our work. After a good hour's interchange of ideas it was plain that each of us had his own idea of what comprised environment and that no two ideas coincided at all points. I was then told what was really altogether new to me. This was that to a large number of our most active and most competent antituberculosis workers environment from beginning to end was nothing more than those physical objects that externally encompass human beings—more concretely, the cities, the streets, the houses and backyards, the rooms in which men live and move, the baths, the windows, the stoves, the furniture, the clothing, the space, air and sunlight which people may or may not have. I was told that there was a certain aggregate amount of all this gear which made up a standard of what is called good hygiene and that a falling short of the standard meant poor hygiene. I learned further that not a few public health workers believed that, if good hygiene—as I have outlined it—were brought to pass and were kept up, tuberculosis as a disease would be checked. And, in answer to my direct question as to who believed this, one or two eminent names were cited.

Now everyone would admit that a thorough cleaning up of our physical environment would in time bring about a disappearance of tuberculosis, simply by removing all chances of contact with tubercle bacilli, even though no other influence were exerted on us. But the very way in which this evening's subject is put indicates that light is desired, not so much on how environment may establish or do away with oppor-

tunities for infection, as on how it may convert a well yet infected man into a sick one or promote those conditions which allow infection to run an uninterruptedly progressive course. Our task is to discover whether environment is in any way responsible for the circumstance that many tuberculous persons fall ill though most remain in health. And, in examining environmental factors we must of necessity pay attention to such purely external surroundings as we have just named.

Yet surely, for our present purpose, this is much too narrow a view to take of environment. There may, for instance, be an environment of disease—of measles, of septic infections, of the common cold, of influenza, to mention only a few. If it be asked whether this type of environment is not necessarily bound up with that of conditions of living and housing we would answer in the negative: for the recent pandemics of influenza, with their frightful toll throughout the world and among all types of civilizations and societies make it impossible to view this particular scourge as influenced by any habits and modes of living such as we are familiar with.

Again, altogether apart from an environment which is to be comprehended under good hygiene there is an environment which would comprise numberless opportunities for physical injury to the person, an environment of perfectly accidental happenings, which neither foresight nor law nor instruction can ever wholly do away with.

There is besides an environment of occupation. The man at the desk or counter, the shoemaker, the tailor, the glassblower, the cab-driver, the farmer, the athlete, the puddler, the miner—all have the physical marks of their trade upon them. The life, the customs, the habits, the demands and necessities of the several classes of society leave their traces on their members no less. If we compare the peasant girl with one gently bred at age sixteen, we not uncommonly find no differences in health, grace and beauty; or, if there be a difference the comparison, as often as not, favors the former. Yet how often have we seen two or three decades of rough, country life ever-vaunted as the road to health and contentment, make of the one a broken woman old before her time, while the same period of ease and urbane life bring to full flower all that was budding in the maiden.

When, sick with angina pectoris and aware of the influence of psychic disturbance upon his physical condition, John Hunter said that his life was in the hands of any rascal in London who chose to take it, he simply indicated the possible more disastrous effects of an environment

about which our books on general medicine are strangely silent yet which drives thousands of us mortals to our practitioners. This is the environment of personal association—of antagonistic personal association, in particular. The older philosophers and brooders over the well being of man were enormously impressed by this factor in human nosology: dust off again your old Burton and see how it appeared to him. Yet, for a considerable period, until recently, when psychiatrists again brought this type of environment into prominence and coined a new nomenclature to speak intelligibily to one another of "conflicts" and the morbid results of these, formal medical instruction, given to more mechanical views of disease, was apparently oblivious to its existence and influence

It should hardly be necessary to point out the enormous amount of functional disturbances which the jarring reactions of personalities bring into being: nor are their effects on already established organic deficiency or disability any less marked. Every physician soon becomes familiar with them and is mindful to attempt to control them when treating his patients. There is a social and a familial environment of amiability and good-fellowship and contentment and happiness: it may exist in surroundings which physically may be far from our accepted hygienic ideal: and its effect on the general well being of those happily situated in it is all good. This much is, I think, beyond dispute. But there is also a radically different environment: one of incompatibility, and oppression and brutality and even bestiality. It is by no means the heritage or appanage of the hovel. It may exist where air and space and light and food leave nothing to be desired; yet even here it will make for ill health. It is at least a debatable statement that the fullest development of the race demands those conditions—that social and political environment—which will allow the greatest freedom and play of individuality. It is nevertheless a commonplace, a criticism in fact, that the great weakness in all ideal commonwealths, from Plato's system down to the actual feeble workings of democracy to-day, is a certain insistence that all men conform to common standards. Out of this struggle between the instinct and passion for self-expression on the one hand and those rules of conduct which, on the other, society deems necessary for its own fixity, innumerable conflicts arise. The issue of these may be acquiescence; but only too often their ultimate effects are what we call misfits, or the apathy of despair or even occasionally self-destruction. And in and by reason of all this welter not a

little physical ill health is brought about. Concerning still another side of this phase of environment—that so ardently played up by Freud and his followers—I think that little need be said here, though I recognize much of the validity of their contentions.

I would not over-emphasize the part played in disease by disturbances of the psyche. I wish merely to point out that it is a very real influence arising out of what is almost man's normal environment whether this be made up of the relationships that exist between him and his kindred or those between him and more casual associates or between him and the ideals and practices of society at large. I do think that to deny its influence on health is to disregard the most obvious phenomena that confront us.

A more detailed recital of what enters into my own comprehension of environment would be superfluous. The long and short of it is that environment comprises all and everything that enters into the experience of a human being; and that, as regards tuberculosis, any experience that may modify in any way the origin and development of infection is an environmental influence.

Perhaps this view is too all-inclusive. It would, for instance make malnutrition an environmental factor, unless in any particular case malnutrition were the result of congenital tissue or organic vice and not of deprivation or improper intake or ingestion. Yet under the latter circumstances, malnutrition is assuredly as much an affair of environment as is the nature of the house one lives in.

At any rate, too great inclusiveness will undoubtedly lead to less misunderstanding than too narrow a point of view. As I see it, only two really fundamental factors can possibly have an influence on disease. These are inheritance or the nature and activities, whether these lie fallow or are at all times fully expressed, of the tissues as these are born into the world; and environment, which includes every mundane experience which, directly or indirectly, may have an effect on the constitution and function of tissues.

There are only two ways in which clinical tuberculosis can develop. These are through the advance or the renewal of activity of foci which have existed, perhaps unknown to the possessor, for variable lengths of time (theoretically, the period may be almost as long as a lifetime itself); and through the development of foci uninterruptedly from the time of infection to the exhibition of symptoms.

Cases of the first type are common and many are comparatively easy of demonstration. We meet with patients whose breakdown is of the nature of a clinical relapse—the third or fourth relapse, it may be, who again become disabled after perhaps years of health, and in whom examination reveals that the particular breakdown is due to renewed activity of foci which were known to exist and periodically give rise to symptoms before. In such patients we are never in any doubt as to the general pathological history; we are convinced that they harbor chronic tuberculous lesions which have undergone periodic scarring and extension or softening.

Or, as not infrequently happens, patients, presenting themselves with symptoms of tuberculosis for the first time, are found to have lesions which, because of their character and extent, are beyond question the culmination of years of infection. Here again we are satisfied that clinical disease is the result of infection received a long time previously. Generalized miliary tuberculosis and acute tuberculous pneumonia in previously healthy adults are invariably the results of extension of infection from preëxisting concealed and quiescent foci: as are osteoarthritic, orchitic, renal, pleural, peritoneal and meningeal tuberculosis, and perhaps lupus. The frequency of clinical relapse plus the frequency of primary symptoms of tuberculosis of the lungs with old and comparatively extensive lesions plus the frequency of primary *clinical* tuberculosis manifesting itself in organs that are not in direct communication with portals of entry is sufficient proof that very, very often clinical breakdown is not the expression of recent infection from without but that it is the result of renewed activity or extension of long dormant lesion.

Were anyone to ask why these cases break down I should answer because of a variety of immediate contributory causes which are often determinable and to which I shall refer in a moment. But over and above all cases in which the sequence of events is plain, prolonged observation of patients and cadavers will bring to light not a few in whom we must conclude that the catastrophe happened because of purely accidental and fortuitous circumstances. The term accidental may be unscientific yet I know of no better way to put the case, which is this—that as regards such things as the focalization of infections and the influence which extraneous factors may exert upon them, there are accidental factors of place and time which may be, which indeed I have no doubt are, decisive in molding the subsequent turn of events—for better or for worse so far as the patient is concerned.

I have taken up this factor of tuberculosis pathology and its results at greater length in another address (1), and have no desire to dilate upon it here. But I may be permitted to repeat that altogether apart from other factors such as dosage of bacilli, etc., the mere point of localization of even the primary infection may be of great moment: a focus in immediate proximity to a large vein or the thoracic duct is, everything else being equal, certainly to be regarded as pregnant with greater evil than one at the very lung apex or in a mid-mesenteric lymph node. We cannot conceive that any element of inheritance, resistance, virulence or *ordinary* environment was responsible for focalization in the one place rather than in the other. There were of course some environmental factors of tissue relations and activities, operating immediately, which did determine the place of localization: but these are beyond the scope of this analysis and are ordinarily not demonstrable. We say that in some instances the place of focalization was accidental and let it go at that.

But note the result. The focus in apposition to the thoracic duct may ulcerate, spreading generalized miliary tuberculosis and death. The ulceration of a similar focus in a submaxillary node would eventuate in a comparatively benign condition.

The stories told daily in consultation rooms and the observations gleaned at the bedside proclaim only too often immediate causes of breakdown from tuberculosis and to me far outweigh any evidence, positive or negative, gained in any other manner. I have lately read several contributions in which the authors report that they have examined the histories of soldiers who developed tuberculosis while in the army, have cast up columns of figures and have found that none of their tuberculous soldiers had received wounds that bore any relation to their tuberculosis. They therefore conclude that *trauma does not bring about clinical tuberculosis.*

Now it might have been perfectly all right for these authors to tell us that none of their cases developed tuberculosis because of trauma; but to say that trauma has no influence on tuberculosis is a totally different matter. It may not in most cases: or the association may be difficult or impossible to detect. But it does have an influence in some cases: and we should remember that when it comes to the complete affirmation or negation of a general principle, a single positive phenomenon or finding will completely outweigh all negative reports, no matter how overwhelming appears the numerical evidence against. Remember the

experience of Claude Bernard and his discovery of glycosuria by piqure of the fourth ventricle. It would probably not be difficult for some surgeons of large experience to prove numerically from their own records that cancer never arises from gastric ulcer: in hundreds of cases of the latter they had never encountered cancer. Yet an obscure country physician may find that his only case of ulcer of the stomach was developing cancer. I have heard some sweeping generalizations about the nonoccurrence of pulmonary tuberculosis with mitral stenosis: yet I have seen a case.

Not long ago I saw a man who, after a sojourn at a sanatorium, returned, a well-arrested case, to follow his occupation as chauffeur. He remained well; until, one day while bending over to crank his automobile, the crank flew off and struck him a violent blow on the left side of the chest where his active tuberculosis had been localized. He immediately developed alarming symptoms of illness and was found to have sustained a pneumothorax.

In this case there cannot exist the slightest doubt as to the influence of trauma. It at once caused a rupture of an already diseased pleura. I have observed haemoptysis to follow a blow and, following the haemoptysis, acute pulmonary tuberculosis which was beyond question the first breakdown that the patient had ever experienced. And this patient at first examination was found to have an entire lung involved with old sclerotic tuberculosis and a cavity at the apex. It is not to the point to ask why she did *not* break down before. What is significant is that trauma precipitated her clinical tuberculosis. In a phthisical billiard player I once saw the most remarkable tuberculosa verrucosa growing between the thumb and index finger of the left hand, in the crotch where the man was accustomed to rest and move his cue.

In my opinion there is not the slightest doubt in the world as to why tuberculosis manifested itself in the manner, both as regards time and place, described in these three cases. We can unhesitatingly affirm that had trauma not been applied, symptoms would not have occurred *when and where they did*. They are all striking examples of environmental influences on tuberculosis. Trauma does bring tuberculosis to light—so much is certain: as to what proportion of breakdowns are attributable to trauma is another matter, which need not concern us here.

At this place it may be well to touch for a moment the influence of pregnancy, labor and the puerperium. There is not a single physician,

be he obstetrician, phthisiologist or general practitioner, who would believe for an instant that the gravid state and its sequelae have no effect on tuberculosis. By far the greater number of women of course go through this experience without exhibiting the least evidence of clinical tuberculosis. But we do not draw our deductions from negative data; and the fact remains that the proportion of tuberculous patients whose breakdown was initiated by pregnancy is still lamentably high. I know of no better examples of the direct influence of what we may call noninheritable factors on tuberculosis than pregnancy will now and again reveal. Consider the following case: A young woman, gently reared and always vigorous and athletic, bears a child and has a protracted convalescence in bed with pleurisy with effusion, which develops very soon after delivery. She recovers completely and outwardly remains in perfect health until the birth of a second child, when she breaks down with acute tuberculous pneumonia.—Or this second case: A woman perfectly healthy, becomes pregnant, bears a child and is then confined to bed for an unusually long period because of indefinite symptoms of illness, although there is some cough. She recovers after a while and two years later has a second child; and, this time during the puerperium she again has cough and fever, and spits blood. Again she recovers and several years later bears a third child, a short time after which she has massive haemorrhages and acute pulmonary tuberculosis.

Every physician could multiply such cases at will. In the case of many of them there can be no question about what caused the breakdown. We can be perfectly certain than an environmental factor, speaking broadly, turned the balance against a continuance of quiescence of lesion. We are no less sure that feeding or inherited qualities or other factors of environment such as unsuitable housing, etc., either had nothing to do with the event or, if they did, they played completely subsidiary parts. The one outstanding fact is that the patient broke down at this time because she became pregnant and bore a child and that, if she had not had this experience, there is not the slightest reason to believe that she would have developed clinical tuberculosis at the time.

Acute, infectious diseases, particularly those which may cause disturbance of the lymphatic or the respiratory system, are very frequently determinants of the outbreak of clinical tuberculosis. Measles, the common cold, influenza, septic infections (especially of the throat), are some of our most notorious "whippers-up" of tuberculosis. We

are familiar with the deleterious effect which a cold may exercise on a patient who is being treated for tuberculosis and who, before being afflicted with a cold, may have been making satisfactory progress toward arrest. We are similarly impressed by the large number of patients who break down for the first time after contracting a cold or an acute bronchitis. In both instances the same interplay of forces is undoubtedly at work: foci which had attained fairly competent investment and thereby relative quiescence participate in the acute congestion brought about by the inflammation of an acute infection and are thus stimulated to fresh activity. Measles may bring about the same result, especially in the lungs and lymph nodes; and, as is well known, may in addition profoundly depress the allergy of the body. So may influenza.

We need not pay detailed attention to the influence of physical and mental stress or excesses of all kinds in promoting tuberculosis. Their action is well understood and their results are so frequently met with in patients that little room is left to question their part either as contributory or decisive environmental factors.

Our point of view concerning the influence of crowded and unsanitary living conditions has shifted considerably during the past decade or two. When it was believed that opportunity for infection played the decisive rôle in tuberculosis morbidity, it was believed that relatively much tuberculosis developed in the tenements because the condensation of population and its consequent evils established quantitatively an unusual degree of contact with the germ. But, as it became more and more apparent that many adult breakdowns occurred on the basis of long-standing infection, newer explanations were demanded.

These explanations are not far to seek and are in general much more rational and nearer the truth than was the older quantitative infection idea. The evils that accompany substandard living arrangements—poverty usually, with its overcrowding, filth, darkness and deadness of air—are plain and need but slight elucidation. People who live in an environment of this kind, with few of the comforts and more refined interests and pleasures of life, overburdened only too often with children, are exposed to all the stresses and deprivations that result from this mode of life—improper or insufficient feeding and clothing, irregularity of menage, overwork, deprivation of the recreative enjoyments with excess of those that are dissipating and vicious, unusual opportunities for contact with many acute infections, lack of proper aftercare in pregnancy and disease, etc. In short, such an environment is our

most fertile soil for the development of conditions which go far toward undermining and breaking general health, and thus lay the train for the lighting up of quiescent infection and bringing it to the field of clinical appreciation. As standards of living go down, ignorance, squalor, exposure to cold and heat, hunger, lack-lustre discouragement and indulgence of bestial appetite increase apace. And one general result can be nothing else than a deterioration of health.

We have been concerned thus far with marshaling an array of factors, all of which are to be looked upon as environmental, which must be taken into account whenever tuberculosis breakdown on the basis of preëxistent lesion comes into question. If we be required to bring forward direct evidence that environment has any influence on tuberculosis and further asked to explain the *modus operandi* of such influence, we would, first and above all, go to therapy to demonstrate our thesis.

There can be no dispute over the general proposition that the intelligent application of what we call hygienic-dietetic treatment will improve the condition of most tuberculous patients. The more intelligent opinion also recognizes that the most effective element of this regimen is the limitation of the patient's activities—a relief from stress which is so prescribed as to meet the individual patient's needs and capacities. The therapy of chronic maladies will provide few more striking examples of functional betterment than that brought about by the judicious use of rest in circumscribed (nongeneralized) tuberculosis. Under its influence the consumptive, to whom, while active, every step was painful with fatigue and every small task appeared almost insuperable labor, finds his whole outlook changed. Put him to bed or fix him to his chair and he becomes comfortable, his fever and tachycardia tend to decline, distaste for food abates and he puts on weight—all this, very often, with astonishing rapidity. A glance through sanatorium reports will show that this is the *institutional* history of fully three-fourths of all patients. And there can be few men, of those familiar with the handling of the tuberculous in our sanatoria, who have not often thought that if the average time of discipline could be lengthened from less than six months, as it now is, to say three years, our ultimate arrest and mortality figures would be completely reversed.

We are of course speaking now of the ordinary patient—not the *phthisicus in extremis*. And, in this connection, close observation of the physical powers of individual patients is highly significant.

While at complete rest, many may be altogether without symptoms. They may even be able to indulge in some activities—walking, for instance—for fifteen minutes, an hour or two hours a day, without functional disturbance. Every phthisio-therapeutist comes to learn the physical limitations of his patients: and he finds that a man who, at a given time, may be able to do fifteen minutes' exercise will suffer if he exceeds this; or that another patient who may go through a whole day of light work comfortably will experience a return of symptoms if put at heavier tasks; or that some who have been practically well for months can be "broken," as it were, if made to do unusual labor.

This simple and common clinical experience, available to all who wish to make the experiment, proves, better than all other evidence, that environment does have an influence on tuberculosis—an influence that is ever powerful and ever active. The constitutional symptoms of tuberculosis are brought about by the action of substances that are absorbed from foci of disease. The amount and rate of this absorption are contingent upon the character of the foci on the one hand and the physiological activities of the tissues enclosing them on the other. The character of foci at any time is largely the net result of antecedent experiences on the part of its possessor:—we may, for instance, alter them at will by certain manoeuvres with animals of experiment. The physiological activities of circumtubercular tissues vary, like those of any other tissues, with the experience of the individual—the experience, which is of course the play of environment upon the person. Physiological stresses and disturbances are set up by environmental conditions of many kinds, whether these be physical or emotional overstrain or disease in general, the latter of which is undeniably closely related to occupation, to position in life, to personal association, to living conditions, and what not, and which produces many physiological effects—changes of respiration, circulation, digestion, metabolism, etc.—which are not to be distinguished elementally from those due to abnormal physical and psychic activity.

At any rate, if environment has no effect in treatment, we may just as well discontinue our present methods and turn our patients loose to follow their own inclinations and to take their chances with the tissue stock that was born in them. Yet, even then, some would adjust their activities so as to create for themselves an environment such as we prescribe. For men suffer when they have tuberculosis. To many such, activity becomes painful—painful to the point of impossibility to

indulge in it. And thus slowed up, they would seek rest, when not a few would pull through or experience periods of relief—those periods which so normally punctuate the natural history of tuberculosis and which quacks have learned to exploit so well.

If, however, environment does influence tuberculosis as we encounter the latter in treatment, then it must also have its effect in contributing to breakdown. Any other view is irrational. If the influence of environment is so delicate that a few minutes' more or less walking means much to the focus which is, as it were, sensitively balanced, its influence on quiescent, latent or concealed foci is no less delicate. True, it may not be so eloquently expressed, if the environmental force remains quantitatively small. A quiet walk of a half-hour would undoubtedly not have produced the least visible effect in the young athlete I knew, who had his first manifestation of tuberculosis—a haemorrhage—immediately after finishing a half-mile run and who is now dead after a prolonged illness with tuberculosis. But relations here are largely those of quantity. The mechanism of going into breakdown, or relapse, or periodic or prolonged increase of activity is fundamentally not very different. The sum of the effects of environmental forces reaches a totality which the balance between foci and surrounding tissues can no longer withstand.

There remains another point of view from which we may discuss the influence of environment on tuberculosis breakdown.

It will be admitted that the presence of tubercle bacilli in one's surroundings is a very real environmental factor. It will also be agreed that this bacillary environment is very variable in quantity and character of bacilli and in the media that contain and transmit bacilli. If, therefore, future observation and investigation should disclose that the continued or repeated attachment of these germs to human beings promotes in many instances the outbreak of clinical tuberculosis, the nature of one's environment may on occasion play a very decisive role in determining the issue of infection.

During the last decade we have become perfectly certain that an initial tuberculous infection endows an animal with increased resistance to reinfection from without (and, as a matter of fact, also from within). At the same time it has become common knowledge that the post-puerile ages of man are rather thoroughly tuberculized.

Out of these two circumstances has evolved the opinion, which in some quarters has hardened almost into dogma, that reinfection is impos-

sible if a person has once been infected and that *all* manifest tuberculosis after childhood develops from infection suffered by the time adolescence is established.

Future work may show that all this is indubitably true. But I have never been able to convince myself that the evidence at hand permits of either proposition as a generalization of fact.

The idea of the impossibility of human reinfection has been based on work contributed from the laboratory. Yet no experimental work that I am familiar with has made as sweeping a statement as that an infected animal cannot be reinfected. Indeed the facts of the matter, the all important details of controlled experiment on animals, point all the other way.

It is true that primary infection of animals confers a high degree of protection against reinfection. But at no time is this ever absolute: sufficiently massive doses will break it down. We also find that even moderate or small reinfections are always met by the animals with some kind of a response. Some kind of tuberculosis never fails to result, even though this be modified. It is not the progressive tuberculosis that results from the same dose of a primary infection, to be sure; but it is tuberculosis none the less; and I have seen it persist for a long time.

Cattle immunization has given us most of our information concerning human immunity. The type of primary infection that results is also most comparable to what presumably occurs in man; that is, in cattle it is aimed to attain a self-limited, well-controlled infection, such as usually takes place in human beings under natural conditions.

Yet it is under these very conditions, that is, when primary lesions are nonprogressive, that we find immunity to exogenous infection to be less high and less permanent. All cattle immunizers have found, for instance, that even after a vigorous course of immunization, satisfactory protection to virulent infection cannot be maintained for much longer than two years. And the results of investigations on cattle and on other animals may be summarized about as follows: (1) primary infection confers protection against reinfection; (2) the protection is not complete; (3) as the primary infection tends to die out, as it will, unless it progresses, the protection diminishes or disappears.

Much more might be said about other more or less decisive features of immunity; as, for instance, about periodic anergy, which undoubtedly exercises an important influence on the issue of events, yet which has never been studied experimentally in connection with immunity and

which has been lost sight of in all applications of allergo-immunology to tuberculosis in human beings. But I think I have said enough to indicate that the proposition, that the average human experience is a single early infection with tubercle bacilli is, to say the least, highly debatable.

The whole matter of human infection must be subject to vastly more complexities than many have assumed. Manifold opportunities for it exist: this much is certain. Between crude sputum and milk and dust and consumptives and the articles these latter handle, that person must be rare who, moving in ordinary society, does not come in contact with tubercle bacilli—not once or occasionally, but frequently. There are, for instance, many habitations in our cities, where children, confined in one or two rooms with careless, phthisical parents, must for months ingest and inhale living tubercle bacilli almost continuously. There must be others, who fed with tuberculous milk, ingest enormous numbers of germs throughout a long period. They do this in sickness and in health—when allergy is high and when, as for example during other acute infections, it is low or absent.

There must also be many whose contact with tubercle bacilli is quite transitory; not a few, whose initial infection is extremely slight. I cannot go into the matter of the complete healing of tuberculous lesions here, other than to say that they do disappear entirely, as the later developments of tuberculous peritonitis have frequently disclosed, and as cattle inoculations have shown. And, until the contrary is definitely proved, we must assume—at least, we cannot deny—that many initial human infections which are comparatively slight are transitory, and that, upon their complete obliteration, immunity dies out or is so slight that the possessors are as open to reinfection as though they had never before come in contact with tubercle bacilli.

Earlier in this address I tried to make plain that breakdown on the basis of old persisting infection comes very frequently into the practice of every physician. But, at the present moment, I cannot convince myself that this type includes all cases of manifest tuberculosis. In view of the immunological details which I have just mentioned and also because of the varying opportunities for infection that exist outside, I cannot help believing that the everyday life of man provides conditions that make for a not inconsiderable number of tuberculous reinfections from without, when the time and quantity of reinfection may be so ordered that, because of these, breakdown results. I do believe, therefore, that, in this respect also, environment may play a decisive part in the development of disease.

But environment is not the only factor that hurries a man into tuberculosis or wards it off. Inheritance must also play its part. The little that we know about specific immunity indicates that at some future time it will be found that a cumulative ancestral experience with active tuberculosis transmits increased resistance to the progeny. But, how much this more resistant tissue stock may be balanced by environmental relations such as greater opportunities for infection from phthisical familial associates and the poorer economic conditions that are the results of consumption in a family, is a question for argument and investigation.

There is not a little clinical evidence that such diseases (to mention only a few) as gout, epilepsy, migraine and cardio-renal-vascular insufficiency arise on an inherited background. It has always been a byword that longevity is inherited. Nervous irritability certainly is. And who knows but that nervous irritability, which at bottom must regulate cellular activity in general, will not ultimately be found markedly to influence the origin and development of infections? I am not here to discuss inheritance; and merely throw out these hints as matters to be thought of, and to emphasize what I said in the beginning—that a narrow view of the development of phthisis is unscientific and not justified by facts or probabilities.

W. C. Gorgas.

Major General William C. Gorgas, M.C., U. S. A.[1]

1854–1920

At its last meeting, in 1920, in St. Louis, the Association honored itself by the unanimous election of General Gorgas to the Honorary Vice-Presidency. The General belonged to us officially, as a director since 1917, but as an Honorary Vice-President he was ours only a few months, for he passed away from his earthly labors on behalf of suffering mankind on July 4, 1920, the day set aside to commemorate the declaration of our political independence. Many were the obituaries which appeared at the time of the great General's death, in all of which high tributes were paid to his achievements. One of the most touching which it was the author's privilege to read was by the General's successor, Merritt W. Ireland, Surgeon General of the United States Army.

William Crawford Gorgas, the son of General Josiah and Amelia (Gayle) Gorgas, was born in Mobile, Alabama, October 3, 1854. General Ireland speaks of the parents and their son William in the following graceful terms:

> General Josiah Gorgas was Chief of Ordnance of the Confederate Army during the Civil War and later president of the University of the South at Sewanee, Tenn. His mother was Amelia Gayle, a famous beauty, daughter of the war governor of Alabama. In lineage and personality, the late Surgeon General was a typical Southerner. He had what might be called the Alabama temperament, a pleasant, suave, affable manner and an attractive disposition, which, wherever he went, made him many friends.

William C. Gorgas received his preliminary and classical education at the University of the South from which he graduated in 1875. He then entered Bellevue Hospital Medical College, receiving his degree as M.D. in 1879, and subsequently served as interne there for two years. He entered the army in 1880 and received a commission as first lieutenant. As his first post he was sent to Fort Brown, Texas, and it was

[1] Honorary Vice-President of the National Tuberculosis Association in 1920.

From the advance sheets of the *History of the National Tuberculosis Association*, by S. Adolphus Knopf.

here that we may say he was fortunate enough to contract the yellow fever which rendered him immune for the great work he was to do later on. He was promoted to captain in 1885, and served during the Spanish American War as Major and Brigadier Surgeon of Volunteers. On July 6, 1898, he received his commission as Major in the regular army. At the close of the Spanish American War Major Gorgas was made Chief Sanitary officer of Havana, in which capacity he served from 1898 to 1902.

General Gorgas's achievements in the combat of yellow fever in Cuba and in the Panama Canal Zone are so well known and have been referred to so often in the obituaries and biographies published of him that we may content ourselves by merely quoting here the following impressive statements from General Ireland's tribute:

> When de Lessep started his ill-fated venture at canal building in 1880, the French occupants found the Isthmus a death trap and during the nine years of occupancy they lost 22,819 laborers from the disease. At this time Panama was called "the White Man's Grave." When the United States took charge of the Canal in 1904, the death rate was as high as ever and a yellow fever epidemic was actually going on. In less than a year's time, the disease was completely wiped out and there was not a single case since May, 1906.

For his work in Cuba Gorgas was made a Colonel and Assistant Surgeon General by special act of Congress in March, 1903. In 1907 he was made a member of the Isthmus Canal Commission and as such he remained in charge of the sanitation of the Isthmus until the winter of 1913.

In 1913, at the request of the British government, Gorgas went to South Africa to investigate conditions in the Rand mines where the natives were dying at a fearful rate from pneumonia, miners' consumption, malarial fever, and tuberculosis. It was here that for the first time the General's interest was centered publicly upon tuberculosis, although from personal conversations it is known to the author that he had always felt a profound interest in the combat of this disease. He had been a member of our Association for a number of years. General Gorgas had indeed a deep insight into the primary causes of tuberculosis as a disease of the masses, such as bad housing, underfeeding, over-work, etc., and did not hesitate to state publicly that our present taxation evils, grants and immunities represent an unjust social order

that is largely responsible for insufficient and unsanitary housing, and poverty and want in general. He was an ardent disciple of Henry George and firmly believed in the single tax system.

Gorgas was an idealist, but an intensely practical one. In one of his most remarkable addresses entitled "Economic Causes of Disease," delivered in Cincinnati, September 29, 1914, he said:

> While dwelling upon thoughts such as these (better housing, better food, and better clothing for the laborers in order to combat disease) I came across "Progress and Poverty." I was greatly impressed by the theory and was soon convinced that the single tax would be the means of bringing about the sanitary conditions I so much desired, and was striving for. It was impressed upon me in a concrete form everywhere, in the United States, in the tropics and particularly in Panama, the great benefit that some such scheme of taxation would confer upon sanitation.

The entire address, which to the men engaged in the combat of tuberculosis has a deep significance, was published by Dr. Walter Mendelson of New York and endorsed by many of our leading sanitarians, medical teachers, sociologists and economists throughout the country.

In South Africa, where General Gorgas had complete command of the situation, he at once inaugurated a campaign for the combat of pneumonia, tuberculosis, miners' consumption, etc., based on the principles of rational hygiene and general human welfare, such as we apply in the prevention of tuberculosis—more air space for sleeping and living quarters, a pure water supply, a sewer system, the destruction of flies and mosquitos, and a better food supply.

On January 16, 1914, Gorgas was appointed Surgeon General of the United States Army with the rank of Brigadier General and in 1915 he was made Major General. During the summer and fall of 1916 he spent several months in South America, making a preliminary survey for the Rockefeller Foundation of localities still infested with yellow fever.

With the entrance of the United States into the World War in 1917, General Gorgas fulfilled the duties of his high office in a remarkably efficient way. The subject of tuberculosis was of course of particular interest because so much work had to be done in order to safeguard our troops from contracting the disease, and it was given close attention. General Gorgas selected for this work the best talent among the military and civilian population. In the general history of our association and

in Colonel Bushnell's biography the work done by the division of tuberculosis in the Surgeon General's Office has already been referred to in detail.

General Gorgas showed his farsighted interest in the tuberculosis problem of the army by appointing Colonel Bushnell to the task of looking after that disease. He saw that the Colonel was not interfered with by other officers and left him free to do exactly what he thought best, so that the responsibility for the course pursued was really Colonel Bushnell's. It is one evidence of the greatness of General Gorgas that having selected the men whom he needed he left them alone, in the confidence that they would do the right thing and without the wish to add to his own renown by taking to himself any credit that might be acquired by the course pursued.

In recognition of General Gorgas's service to medical science and to humanity at large, many honors were conferred upon him. He was awarded the Distinguished Service Medal of the United States and was made Commander of the Legion of Honor of France. He was knighted by King George of England and decorated by King Albert of Belgium, as well as by rulers of other foreign countries. Honorary degrees were conferred on him by the University of Pennsylvania, University of the South, Harvard, Brown, Alabama, Tulane, Johns Hopkins, Oxford, Lima, and other universities. His alma mater, now the New York University and Bellevue Hospital Medical College, conferred on him the degree of LL.D. in June, 1918, in the midst of the great war. A brilliant assembly gathered in the amphitheatre of the college to pay homage to their distinguished fellow alumnus. It was largely composed of physicians training for or already active in war work. At the conclusion of the ceremonies, the General made a gracious address, expressing his appreciation of the willingness of the American medical profession to do its duty in the great war. He congratulated those present on having the great privilege to serve their country in an hour of greatest need, bidding them an affectionate Godspeed. He concluded by saying that he hoped soon to see them all on their job. Many of those present he hoped to meet in France for which country he was about to sail with the Honorable Newton D. Baker, the Secretary of War. Besides the honors conferred on General Gorgas which have just been mentioned, he was awarded the Mary Kingsley medal from the Liverpool School of Tropical Medicine (1907), a gold medal of the American Museum of Safety (1914), and a special

medal from the American Medical Association (1914). Besides being President of the American Medical Association in 1909-1910, he was a member of the American Society of Tropical Medicine, American Public Health Association, and Association of Military Surgeons; Honorary Fellow of the New York Academy of Medicine, and of the College of Physicians of Philadelphia, and Associate Member of the Societe de pathologie exotique de Paris.

After his retirement from active duty in the Army, during the year 1919, General Gorgas was occupied with yellow fever investigations at Guayaquil and other South American foci, and in 1920 the question of exploring the African foci came up. General Gorgas reached London on his way to West Africa on May 19, apparently in the best of health, and after a short period of travel on the continent, during which time he was decorated by King Albert of Belgium, he returned to London on May 29th. On the following day he had a stroke of apoplexy from which he never recovered. The funeral ceremonies in London and in Washington were conducted with the military and civil honors becoming his rank and his distinction.

To characterize the man Gorgas, we may be permitted to quote again from General Ireland's tribute: "Reticent and shy in public address, kindly, modest and unselfish in authority, patient and openminded, General Gorgas stands as one of the great figures in the application of science to the conquest of disease." To have known him intimately was indeed a privilege and his kindly face will never be forgotten by those who served with him, or under him, or came into personal contact with him socially. We are indebted to Mrs. Gorgas for the photograph of the General which she considers most excellent and the best ever taken of him. It was taken just before his retirement from the Army.

With the passing away of General Gorgas the world has lost one of the greatest medical authorities of the American Army, a true benefactor of mankind, an ideal soldier, and a most lovable man. His achievements in preventive medicine have placed his name among the great immortals of the age.

S. ADOLPHUS KNOPF.

STUDIES ON THE RELATION OF MINERAL DUSTS TO TUBERCULOSIS

I. THE RELATIVELY EARLY LESIONS IN EXPERIMENTAL PNEUMOKONIOSIS PRODUCED BY GRANITE INHALATION AND THEIR INFLUENCE ON PULMONARY TUBERCULOSIS

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In the spring of 1918, an experiment was started to demonstrate the effect of the inhalation of marble dust on pulmonary tuberculosis in guinea pigs. This work was undertaken in an attempt to ascertain whether calcium, introduced in large quantities into the lungs, would influence the course of a tuberculous infection. Later the work was extended to include comparative studies on other inorganic dusts.

The present communication will deal with certain aspects of one of the latter group. As will be seen in the following brief review of the literature it is quite generally believed that the inhalation of siliceous dusts in various industries tends to increase the incidence of pulmonary tuberculosis to a very marked degree. In a recent statistical study among the granite workers in Vermont, Frederick L. Hoffman has stated that during the ten year period from 1906 to 1915 the death rate from pulmonary tuberculosis was 143 per 100,000, while the rate for the whole state, irrespective of occupation, during the same period was only 90.6 per 100,000. In this same interval the death rate from this cause in Barre city, the centre of the granite industry, was 233.2 per 100,000. These and other statistical data have been compiled from a study of death certificates. Such sources of information are notoriously inaccurate. In the differentiation between advanced pulmonary tuberculosis with fibrosis and the lung sclerosis due to the inhalation of dust it is often necessary to resort to bacteriological examination and to the use of the X-ray. At the time these statistics were compiled such measures had not been used as routine procedures. It would seem best therefore, to refrain from accepting these statistics at their face value.

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These experiments have been undertaken in an attempt to demonstrate experimentally whether there is a direct relationship between the pneumokoniosis induced by inhalation of granite dust and pulmonary tuberculosis. It is hoped that under properly controlled experimental conditions some light may be thrown upon the subject.

The literature presents several classic studies on the changes produced in the lungs by the inhalation of dust of various kinds; and although it has been generally admitted that tuberculous infection occurs often as a terminal event, the interest of most of the authors has been centered on the pneumokoniosis and not on dust as an etiological factor in the production of pulmonary tuberculosis. From the point of view of descriptive and experimental pathology three reports are of especial interest. The General Report of the Miners' Phthisis Prevention Committee of Johannesburg, South Africa, in 1915, gives a thoroughly scientific discussion of the human pathology both in pure pneumokoniosis and in those cases where tuberculous complication is superimposed. Subsequent papers by Watkins-Pitchford (27), a member of this committee, throw much light on the mechanism of the development of the lesions. A report to the Secretary of State for the Home Department on the health of Cornish miners by J. S. Haldane (8) and others has given rise to much valuable experimental work in England, and Collis's (4) scholarly review of industrial pneumokonioses in the Milroy Lecture of 1915 contains much valuable data. In addition, much information on the general subject of lesions produced in the lung by the inhalation of various kinds of dust has been afforded by the studies of Arnold (1), Mavrogordato (20), Klotz (12), Haythorn (10), and Cesa-Bianchi (2).

All agree that siliceous dusts are injurious when inhaled over a considerable length of time. As to what the actual mechanism of this injury may be, opinions differ. Watkins-Pitchford (28) (29), and most of the observers preceeding him, attribute the injurious quality of a given dust to the mechanical irritation produced by sharp cutting particles. This irritant reacts upon connective tissue cells with resultant proliferation. He says:

In pneumokonioses, the lymphatic channels are not dilated, for their obstruction is not due to the plugging of their channels by foreign bodies—the channels are obliterated by the hyperplasia and induration of the normally loose and delicate tissues through which they pass. This perilymphatic induration

is a local process due to the irritation of the connective tissue by foreign particles in its interstices; having once formed it tends to obliterate the lymph channels, and thus a far more extensive hyperplasia due to lymphatic obstruction may be originated.

Haythorn (10) describes the development of similar perilymphatic connective tissue proliferation in lungs long exposed to coal dust. Krause (16) would explain the increased susceptibility to tuberculous infection of a lung previously exposed to dust on an anatomic basis, that is, as due to a mechanical blocking of the lymphatics which provide means of exit from the lungs. Tubercle bacilli then entering such a lung cannot be eliminated as under normal conditions and they remain within the tissue, proliferate and produce widespread lesion.

Haldane (9) believes that dusts are not injurious in proportion to the amount of crystalline silica which they contain, but that their noxious properties are due to inherent characteristics which cause them to remain within the lung for long periods. Remaining there, they stimulate the proliferation of connective tissue which restricts function. He believes that certain dusts possess the power to stimulate the phagocytes "to wander out with their load of dust particles." All dusts are phagocyted within the lungs but only with certain kinds of dust do these phagocytes remove the irritant. This peculiar property of stimulation of the migration of phagocytes he attributes to some undefined substance absorbed by the dust itself. He enquires:

> Why is coal or shale dust easily removed from the lungs, but not siliceous dust, and why is pure quartz so difficult to remove whereas the larger portion of quartz in shale is removed quite easily? If the danger were due to the mere hardness or sharpness, crystalline dust, even when mixed with other dust might be expected to be dangerous; yet quartz in shale and other hard dust are actually harmless in practice. The mechanical composition of the stone does not seem to matter but a quality in the dust that does seem to matter is its power of absorbing other substances. Particles of coal dust and other insoluble carbonaceous matter possess this power to a high degree . . . . but crystalline substances like quartz seem to have very little absorptive power. The particles of quartz are taken up by the dust collecting cells . . . . if enough of the juicy absorbent particles are also present they will stimulate the cells sufficiently and consequently the whole dust including the quartz will be removed. In this way it will be seen how a mixture of quartz with silicates, as in shale and the dust from many hard stones, causes no injury.

Cesa-Bianchi (2) has reported some rather pertinent experiments which would seem to establish a direct relationship between pulmonary tuberculosis and dust exposure. He offers no explanation of the mechanism by which the process occurs but simply states that a point of lessened resistance to tubercle bacilli results in the lungs after exposure to dust of any kind. He has demonstrated to his own satisfaction that if guinea pigs are exposed daily for eight to ten weeks to inhalations of dust, siliceous or otherwise, their lungs become hypersusceptible to subcutaneous inoculation of tubercle bacilli of low virulence. Undusted controls, similarly inoculated, show little or no pulmonary involvement. Unfortunately the details of his experiment are very meager.

In summarizing his lecture Collis (4) says:

> Silica dust then possesses certain qualities (1) physical, (a) such smallness as permits the particles to be carried into the alveoli, and (b) such hardness and angularity as suggest that the particles can act as centres of irritation: and (2) chemical, (a) acidity, which, owing to the presence of the element silicon, may render the particles capable of entering into and modifying the colloidal structure of protoplasm, and (b) smell, possibly due to a vapor, as yet undetermined when silica is fractured. Only further investigation can determine which it is that leads the pulmonary connective tissue to proliferate, and whether the undoubted predisposition to pulmonary tuberculosis caused by inhaling silica dust is due to this proliferation.

From this superficial review of the more prominent opinions on the action of dusts in tissue it will be seen that further experimentation, even though it repeat work already done, is well justified. Our knowledge is built up step by step in small increments. If the present study can add one new observation, the apparent repetition of some of the older work is justified.

The irritant. Examination of the granite dust received from Barre shows a fine powder generally white in color and containing relatively few black and grey glistening particles. When the dust is poured from one container to another a very fine cloud arises which remains suspended in the air for several seconds. This cloud is quite irritating to the nasal and pharyngeal mucous membranes and often produces coughing and sneezing if inhaled.

When examined under the microscope the unscreened dust may be roughly divided into large and small particles. The former which could

not possibly be concerned in an inhalation experiment show an average size of 82 x 84μ (ocular micrometer measurement). The smaller particles average 4.3 x 6.3 μ with a minimum of 0.28 x 1.4 μ, by actual measurement. There are also other more minute particles which could not be measured with the apparatus at hand. In shape the particles may vary greatly. Some are flattened polygonal masses with sharply cut edges and corners; others are rod-shaped, often slightly curved with sharply pointed or square-cut ends. There are also clumps of brown amorphous material to which adhere great numbers of minute glistening sharply cut dust particles. Frequent vegetable cells and fibres are noted. With polarized light most of the particles are doubly refractile although it is sometimes difficult to demonstrate this phenomenon in the smallest particles.

Nelson Dale (3) of the U. S. Geological Survey gives the chemical analysis of "dark Barre granite" as follows:

SiO_2 (silica)	69.89	NaO_2 (soda)	4.73
Al_2O_3 (alumina)	15.08	K_2O (potash)	2.29
Fe_2O_3 (iron sesquioxide)	1.04	H_2O at 110° (water combined)	0.31
[2]FeO (iron oxide)	1.46	H_2O ignition (water combined)	0.23
MgO (magnesia)	0.66	P_2O_5 (phosphorus pentoxide)	trace
CaO (lime)	2.07		

In attempting to demonstrate experimentally a relationship between pneumokoniosis and pulmonary tuberculosis, guinea pigs have been exposed to a given concentration of dust for varying lengths of time. They have been infected with tubercle bacilli at various intervals preceding, during, and following this exposure. Control animals have been exposed to dust alone and another set of controls to tubercle bacilli alone. In order to reduce to a minimum the error from individual variation a large series of animals has been employed. Careful gross and microscopic studies have been made on each.

In the present paper it is attempted to show:

1. The effect on the development of pulmonary tubercles when dust inhalation is started at the time of infection.

2. The effect of previously established pneumokoniosis in its early stages on subsequent infection with tubercle bacilli.

[2] The granite cutters complain that their "trouble" is due to the steel chips from the chisels and state that if a magnet be drawn through the dust from the floors a large amount of steel can be collected. On attempting the experiment, some small, and a few large particles were found, but in no great amount. Microchemical tests on the lungs of animals inhaling the dust have failed to show the presence of any iron.

Experiments are in progress, attempting to demonstrate:

1. Whether pneumokoniosis tends to favor or prevent the spread of pulmonary tuberculosis.

2. Whether subsequent exposure to dust will light up a quiescent tuberculous lesion.

Moreover a careful study of pneumokoniosis, exclusive of infection, has been made in an attempt to understand the mechanism by which dust enters the lung, its distribution and ultimate disposition, and the reaction on the part of the lung to this irritant.

TECHNIQUE

Dust exposure. After repeated attempts extending over nearly a year the present device (fig. 1) has been adopted as offering a satisfactory means of delivering a fairly constant volume of dust of sufficient concentration to a large number of animals at one time. The dusting machine consists of a box 6 x 3 x 2 feet. The front is a removable glass window and the sides are hinged doors which facilitate cleaning and removal of the animals. In the interior are two racks, one on either side of the machine, measuring 6 x 2 x 1 feet, and each holding six pans (12 x 24 inches) placed one above the other, with a vertical space of 4 inches between each pan. The racks are covered by heavy wire netting. Each pan will accommodate three or four guinea pigs without overcrowding. Between the two racks is an air space 1 foot wide, 2 feet deep and 6 feet high. At the bottom of this central space is a dusting barrel arranged like a churn with the top removed. A water motor causes a paddle in the barrel to revolve and agitate the dust which rises to the top of the box in a moderately heavy cloud. The barrel needs filling only once a day as a large amount of the dust falls back into it to be used over and over again. The possible objection that those guinea pigs on the upper pans may receive less dust than those on the lower ones is met by daily reversing the position of the animals. Such a machine accommodates fifty animals.

It has not yet been possible to measure the concentration of the dust with the devices employed in industrial investigations but it is hoped that in the near future this may be done.

Guinea pigs have been employed in this research, owing to their relatively low cost and to the readiness with which they lend themselves to tuberculosis experimentation. They are not ideal animals for dust observations in that, being rodents, they are normally exposed to dust of various kinds. Experience, however, enables the observer to differentiate the granite dust from other accidental varieties.

After feeding in the morning the animals are placed in the machine and exposure is continued from six to eight hours daily with the exception of

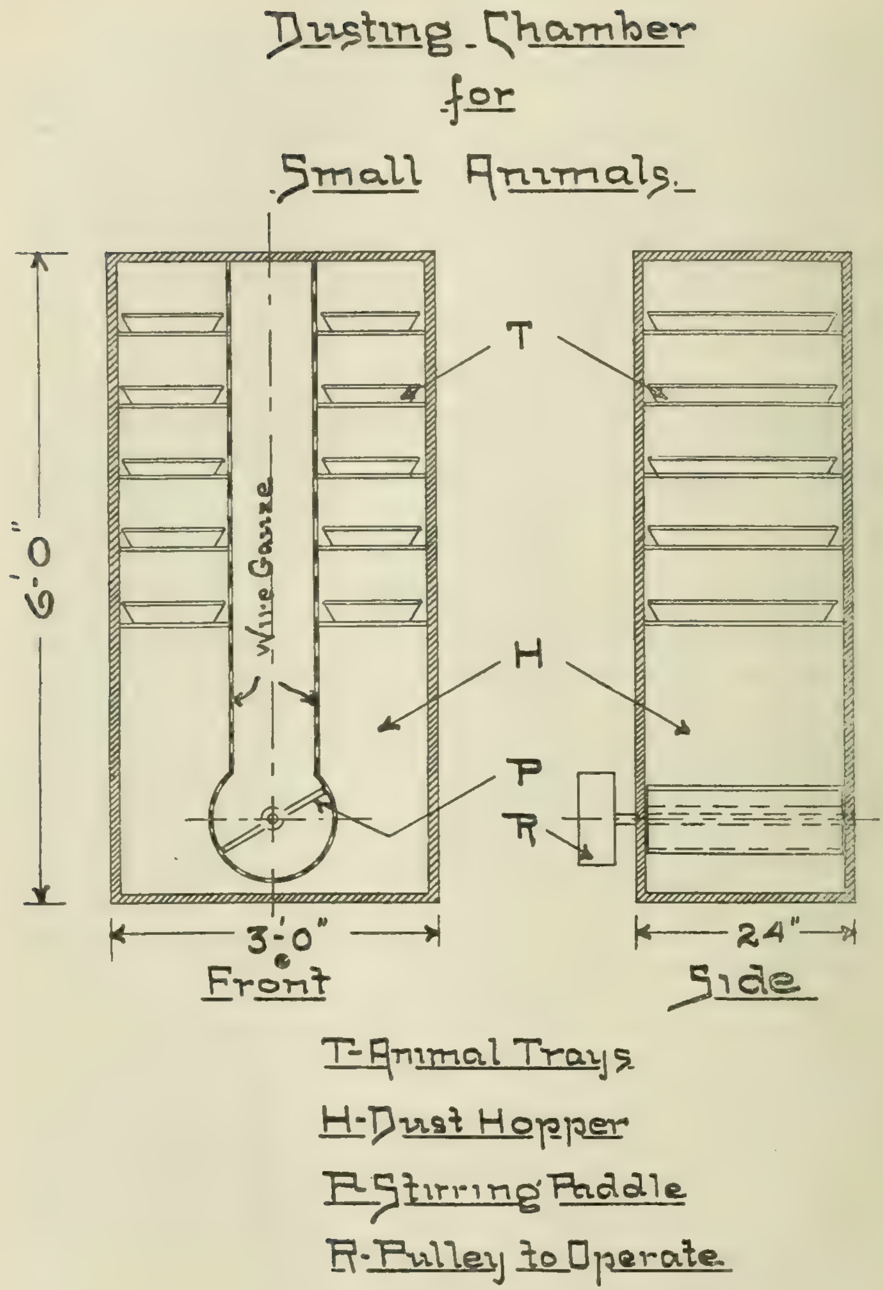
Dusting Chamber
for
Small Animals.
6'-0"
Wire Gauze
T
H
P
R
3'-0"
Front
24"
Side
T-Animal Trays
H-Dust Hopper
P-Stirring Paddle
R-Pulley to Operate

Fig. 1.

Sundays. Experience has shown that prolonged exposure is necessary for the development of lesions due to granite dust and in consequence this treatment has been continued from two to seven months. Many of the pigs suffer no ill-effects, but there is a marked tendency for the animals to develop chronic organizing infectious bronchopneumonia, usually due to pneumococci. This is very annoying and necessitates again the use of a large number of animals.

Infection. The animals are infected by inhalation with a moist spray, using a method devised by Dr. Baldwin. A bit of growth, 6–8 mm. in diameter, is removed from the edge of a two weeks' glycerine broth culture. It is ground in a mortar with a very small amount of broth until a thick homogeneous suspension results. This is taken up in 10 cc. of broth and centrifugated at low speed for five minutes. The supernatant fluid is placed in a DeVilbis vaporizer. The pig to be infected is held in a section of inner tire tube about 10 inches long, one end of which has been tapered and vulcanized to give an opening sufficiently large to allow the pig's nose to protrude. An assistant holds the pig in the tire tube with one hand and with the other he holds against the projecting nose of the animal a piece of glass tubing 1 x 6 inches. The operator then places the nozzle of the vaporizer in the other end of the glass tube. Five puffs with the vaporizer given slowly are sufficient to infect the animal. The operation is of course carried out under a hood with a strong draught. When the spray is directed against a slide freshly smeared with albumin, from two to five single bacilli to an oil immersion field with occasional small clumps are seen.

Strain of tubercle bacillus. In the experiment reported in this paper an organism known as R1 has been exclusively used. It has been under cultivation for twenty-nine years. In guinea pigs local lesions at the site of inoculation, which do not spread except to adjacent lymphoid tissue and which tend to heal, are the rule. In the lungs following inhalation-infection, healing takes place to such an extent that within a year's time little or no trace of tubercles can be found microscopically.

Treatment of tissue. In preparing the lungs for microscopic examination the methods of Miller have been exclusively used. After killing the animal with chloroform the trachea is exposed: two ligatures are loosely placed about the trachea; and the thorax is compressed to expel as much air as possible from the lungs. With the lungs still compressed the upper ligature is firmly tied just below the larynx. A large needle is inserted into the trachea directly below this ligature and with a syringe the fixative (usually Zenker's fluid) is injected *very slowly* through the trachea into the lungs. The amount of fluid injected varies with the size of the animal but the proper degree of distention can be determined by placing the hand over the thorax and noting its tension. Usually from 25 to 35 cc. can be injected without overdistending the lungs. The trachea is then securely tied by the second ligature placed

below the point of injection. After fixing the lungs the abdomen is opened, the diaphragm is cut away, and the ribs and sternum are removed from below. The trachea, heart, lungs and mediastinal tissues are removed *en masse* and placed in more of the fixative. Occasionally lungs are examined *in situ* before fixation. In this case, the fixative must be very slowly injected to avoid over distention.

The pieces of tissue selected for microscopic examination are subjected to a partial vacuum while in alcohol to remove as much air as possible so that the processes of dehydration and imbedding may progress uniformly and rapidly. For thin sections paraffin imbedding has been employed, but for thick serial sections celloidin is preferable. Sections are stained by haemotoxylin and eosin, Mallory's eosin and methylene blue and connective tissue stains, Verhoeff's elastic tissue stain, and the Ziehl-Nielsen stain.

DESCRIPTION OF LESIONS

In animals exposed to dust alone no macroscopic lesions can be detected until about the seventh month. If at that time the unfixed lung tissue be carefully examined immediately after opening the thorax, a delicate green-brown tracery of dust deposit can be detected on the subpleural surface along the antero-inferior borders of the cephalic lobes. A few smaller similar deposits occur on the vertebral borders of the caudal lobes. This coloration quickly disappears on exposure to the air, probably because of coagulation changes in the tissues which render them opaque. Zenker fixation, of course, obscures this pigmentation.

If infection by inhalation be superimposed upon the dusted lung, the resulting tubercles are more numerous and larger than those occurring in infection control animals. They are usually well distributed over the pleural surface of all the lobes. No macroscopic relationship between dust and tubercle can be established.

Gross dust deposits have never been detected in regional lymph nodes nor is there any enlargement of these nodes in pure dust animals. The mucous membrane of the upper respiratory tract has never presented macroscopic lesions.

Microscopic lesions are of more interest; but to appreciate their significance it is necessary to compare them with control animals, one series made to inhale dust alone and another, tubercle bacilli alone. The lesions are therefore summarized under the following heads:

1. Pure dust changes
2. Pure inhalation pulmonary tuberculosis
3. Changes due to the combined inhalation of dust and tubercle bacilli

1. Pure dust changes. After about three weeks' exposure small amounts of dust may be found, enclosed in mononuclear intraälveolar cells, which often show mitotic figures. These cells are scattered everywhere in the alveoli from the pleura to the hilum. A very small amount of dust is caught in ciliated epithelium of the trachea and bronchi. At about two months some of these intraälveolar dust cells have begun to mobilize and have formed considerable collections, often so closely packed as to simulate giant cells. These cell masses lie in the alveoli along the course of the ductuli alveolares and about and within the small lymphoid collections occurring in the periphery of the lung. As Miller (21) (23) has shown, such collections occur at the distal ends of the ductuli alveolares and at the division points of vessels. Large collections of dust cells also occur about the proximal sides of alveoli adjacent to more immobile structures like vessels and bronchioles. Smaller deposits are often seen in subpleural alveoli. A very slight amount of connective tissue proliferation may occur in adjacent alveolar walls. Dust has already passed through the lung and lodged in small amounts in the tracheobronchial lymph nodes.

From three to seven months the same process continues with a steady increase in the amount of dust deposit. The invasion of lymphoid tissue of the lung is more extensive and the larger nodules located at the bifurcation of the bronchioles and bronchi become involved. All of the lymphoid tissue of the lung becomes very active and mitotic figures are very common even in the normally small peripheral collections. Occasionally a dust cell is noted in transit lying within a dilated peribronchial or perivascular lymphatic. There is only slight local proliferation of connective tissue in alveolar walls and no nodule formation occurs. The medullary sinuses of the tracheobronchial lymph nodes contain intracellular dust deposits, but these do not involve the tracheal nodes located just below the larynx. No dust has ever been found in the liver or spleen. Occasional small deposits occur in the intestinal content but none has been seen in mesenteric lymph nodes.

If the animal be set aside after dust exposure the lung makes rapid and effective efforts to rid itself of the irritant. The clearing process has been observed only up to three months in animals dusted for seven months previously; at that time practically all the dust is collected within large aggregations of round or oval mononuclear cells which lie in the immediate vicinity of much enlarged lymph nodules. Heavy deposits occur within such nodules and within the tracheobronchial lymph nodes. Some dust still remains within alveoli along the ductuli alveolares.

2. Pure inhalation pulmonary tuberculosis excited by the R1 Strain. At three weeks there are large proliferative subpleural tubercles with well-defined caseous centers, the whole being capped on the pleural surface with young granulation tissue. In the midzonal region of the lung are many proliferative masses within alveoli, located usually about ductuli alveolares. They are composed of groups of cells with long pseudopodial processes, and often show mitosis in individual members of the mass or plaque. Tubercle bacilli have not been found in such plaques. The tracheobronchial glands are already involved by proliferative tubercle which frequently shows early caseation.

At two months the *subpleural* tubercles have become somewhat smaller and have a shrunken appearance. The area of caseation appears coarsely granular and the proliferative zone is composed of loose fibrous connective tissue with a diffuse lymphocytic infiltration. The *midzonal* intraälveolar proliferative masses have become larger, fibrosis of the adjacent alveolar walls is in progress, and in some instances caseous tubercles have formed in these areas. The small peripheral lymph nodules are enlarged and often contain early proliferative tubercle.

At three to four months the *subpleural* tubercles are being invaded by phagocytes of both polymorphonuclear and mononuclear types. At the periphery the outlines of alveoli become visible although still much thickened by fibrous tissue and lymphocytic infiltration. In some instances the capillary of the wall is discernible. Some of these peripheral alveolar walls show very marked regeneration of the lining epithelium, with cells large and swollen often presenting frequent mitotic figures. Other alveoli are lined with cuboidal epithelium. A much enlarged active lymph nodule often lies just beneath such a healing tubercle.

At six to seven months all that remains of these *subpleural* tubercles is a focus of alveoli with somewhat thickened walls lined by cuboidal epithelium. The usual underlying lymph nodule shows no evidence of tubercle but is still large with frequent mitoses. The proliferative foci in the midzonal region have in the meantime been undergoing the same change. Some have gone on to the formation of caseous tubercle and are then being resorbed, or in other instances the process does not advance this far and the cell plaques are invaded and removed by phagocytes.

The tracheobronchial lymph nodes show a more progressive type of involvement due to the greater number of bacilli which have been con-

centrated at this one small focus. Lesion here may persist for two or three years, and perhaps longer.

The above outlined progress of the disease produced in guinea pigs by the inhalation of R1 is not always constant in that it may take a longer or a shorter time for the various stages to occur. For instance, in some series subpleural tubercles may persist at five or six months. But in this particular series of animals infected with this given dose of R1 the sequence was as described. The important fact remains incontroverted that *such lesions can and do heal with a complete restoration of normal structure and apparent resumption of function.*

3. Changes due to the combined inhalation of dust and tubercle bacilli. The character of the lesion varies with the relative time at which the lung is exposed to the action of these two irritants. In consequence they will be summarized under three heads:

1. Dust inhalation coincident with infection
2. Dust inhalation during the course of a previously established infection
3. Infections of the previously dusted lung

1. Coincident dust and infection. Tubercle formation occurs in the same locations as in lungs exposed to infection alone but the lesions are more numerous, much larger and show less tendency to regular zonal arrangement. The relative amount of caseation is little different from that in the infection controls. Proliferation of cells of all types, but especially of fibroblasts, occurs early and reaches a degree of development far in excess of that in simple tubercles. In consequence of this overstimulation of fibroblasts in and about these tubercles the lesions persist for a much longer time. At seven months the oldest combined lesions yet studied, the subpleural tubercles, were only beginning to decrease in size while those of the midzonal region were still at the zenith of their activity, a stage corresponding to that seen at two months in the infection controls. Some of the dust is distributed as in the infection controls within phagocytic cells at the points of exit from the lung where these have not been involved by tubercle. Scattered deposits also occur in the other locations noted, that is, along vessels and bronchioles, and beneath the pleura. The largest portion, however, is collected in and about tubercles and is contained in aggregations of separate cells so closely packed as to suggest giant cells. Such cell masses, heavily laden

with dust, are found in the alveoli surrounding the tubercles. The walls of these alveoli have undergone fibrous thickening and show heavy lymphoid infiltration, the whole giving a very irregular outline to the lesion. There is also considerable dust contained in mononuclear cells which lie within the proliferative zone of the tubercle itself, and small amounts are sometimes seen within the caseous centre.

It would seem that since so much dust is held in and about tubercles, very little enters the lymphoid tissue and it is not until about the third month, one month later than in the dust controls, that even small deposits can be found in pulmonary lymphoid tissue. Not until the sixth and seventh month is any large quantity mobilized when it is found both within the pulmonary lymphoid tissue and within the tracheobronchial lymph nodes. Moreover, if the animal is allowed to live for some time after the cessation of dust exposure, the dust tends to collect in greater quantities about tubercles than in lymphoid tissue. It will be remembered that in dust controls cessation of dust exposure before death allowed the lungs to rid themselves of the dust quite effectively.

A new type of lesion is encountered where both irritants are acting simultaneously upon the lung. This is a nodular fibrous focus located in the subpleural and midzonal regions. It is composed of rather dense connective tissue enclosing alveolar spaces lined by cuboidal epithelium and also occasional blood vessels and lymphatics distended with lymphocytes. Dust is found in cell plaques lying within the enclosed alveolar spaces and to a lesser degree within phagocytes lying between the connective tissue cells. No trace of caseation has been found and tubercle bacilli have never been seen although they are very numerous in nearby caseous tubercles. It seems likely that such nodules are early focal fibroses occurring at the site of the small peripheral collections of lymphoid tissue.

2. *Infection during the course of dust exposure.* In this experiment animals were exposed to dust for three months and then infected by inhalation of R1. The dust was discontinued and the animals were allowed to live two months and eleven days. The results in these animals differ from those in the preceding group (coincident exposure) in that the tubercles here are even larger and show greater connective tissue proliferation. Caseous lesion is found in the tracheobronchial nodes.

If the dust exposure be continued throughout the course of life after infection the only difference noted is a heavier deposit about the tubercles. Some of the dust escapes through the lymphatics.

3. Infection superimposed upon a previously dusted lung. These experiments were entirely unsatisfactory, for the animals were exposed to dust so long after infection (ten months to two years) that all traces of tubercle had disappeared. They reacted to dust in every respect as normal animals. A repetition of this experiment is contemplated using animals whose infection may be presumed to be in the early stages of resorption in an attempt to obtain a recrudescence of the lesion.

DISCUSSION

Many observers have recommended the polarizing microscope for the detection of siliceous dusts in tissue. In this work it has proved unsatisfactory as a means of identifying particles which could not be seen by ordinary lighting. In the early stages when individual cells contain one or two particles which are visible only with an oil immersion lens the polariscope has proved untrustworthy unless the particle in question is well separated from the surrounding structures. The upturned edges of red blood corpuscles show very strong doubly refractile powers and are apt to be misleading. In a pneumonic lung with transudation and phagocytosis of erythrocytes the microscopic field is ablaze with doubly refractile particles. Of course where masses of cells distended with crystalline silica lie free in an alveolus or within lymphoid tissue beautiful pictures are obtained, but for the detection of isolated particles this method has proved unsafe.

It is with considerable hesitancy that the question of the intraälveolar phagocyte is introduced. Although the subject is timeworn and although the interpretation of microscopic findings must depend so much upon the personal experience of the observer, yet such beautiful examples of intraälveolar phagocytosis are found in such an experiment that it is necessary to touch upon the subject in brief.

Consider the physiology of the condition: There is a sudden demand for a great number of phagocytic cells to remove an enormous number of minute foreign bodies which are poured into the alveoli without warning. Given such a demand, it is to be expected that the cells whose duty it will be to remove such foreign bodies will show increased activity.

As such a demand is far in excess of the ordinary, one of two things must occur, either circulating cells will be mobilized from distant organs or there will be local proliferation of some type or types of cell. A study of lungs during the early stages of dust inhalation would indicate that the organism is attempting to meet this demand by the latter method, that is, local proliferation within the lung itself. Within the blood and lymph vascular systems are very many cells in mitosis, often three or four to a single oil immersion field. The capillaries are so small and the cells are so much enlarged during division that they fill the whole lumen and in consequence it has not yet been possible to definitely assert whether such cells in division are lining endothelium or whether they are circulating cells. At any rate here are cells showing great activity and it would seem probable that they are the progenitors of the intra-alveolar phagocyte. In support of the circulating cell origin is the work of McJunkin (24) who has shown that the so called "transitional cell" of the blood may be phagocytic *in vitro*. He (25) has also shown that the number of such cells may be increased in certain chronic infections. Although he is not yet certain that such cells are always the result of local proliferation in the organ where they are needed, he believes that they originate in endothelium.

In the present investigation a somewhat superficial study of the liver, spleen, bone-marrow, and lymph nodes has failed to reveal any evidence as to their possible origin. True, the lymph nodes are hyperactive but it has seemed that this activity occurs in lymphoblasts which are giving rise to lymphocytes. These cells are certainly not phagocytic. Now consider the fixed cells of the organ, the only activity seen is within the blood and lymph vascular systems. The classic studies of Mallory (16) have repeatedly shown that other organs when subjected to relatively mild stimulation present marked proliferative changes in the endothelium of the smaller vessels. These cells undergo division, the daughter cells migrate through the vessel walls and enter the surrounding tissues, where they show further division figures, and then become phagocytic. This process is beautifully illustrated in his recent studies on the early skin lesions of measles. Foot (5) (6) has brought vital staining methods to bear upon the problem and has likewise concluded that the cell in question is of vascular endothelial origin.

Others studying similar material have reached different conclusions. Without in any way attempting to review the enormous literature, a few of these suggested origins may be mentioned. Tchistovitch (27)

in dust inhalation experiments carried out on very young animals concluded that such cells were of lymphoid origin; and also Miller (23), after a study of a rat caught in a coal bunker, has stated that such cells strongly resemble the lymphoid series, especially in nuclear characteristics. Arnold (1) believed that some of these phagocytes were derived from lymphoid cells and that others arose from alveolar epithelium. Haldane (8), Watkins-Pitchford (28), and others consider all alveolar phagocytes to be of epithelial origin.

A study of nearly one hundred dusted animals has failed to reveal the presence of a mitotic figure within alveolar epithelium during the stage of phagocyte formation. Moreover no trace of dust has been found *within* an attached alveolar epithelial cell. One of Miller's great contributions to our understanding of pulmonary anatomy has been the distention method of fixation. By its use it is possible to determine with a considerable degree of accuracy the relation of one structure or cell to another. If a collapsed or undistended lung be examined it seems indisputable that dust particles are lying within attached epithelial cells. If, however, the lung be fixed by the distention method the dust cells, although they may be near the wall, will always be superimposed upon the epithelium or lying at a little distance from the wall. It would seem that the employment of this technical procedure has enabled us to eliminate one of the proposed sources for the intraälveolar phagocyte.

No definite conclusions on this disputed question are possible at this time. The evidence would seem to have reduced the question of the origin of the alveolar phagocyte to a consideration of the local vascular endothelium in the lung and to studies on the transitional cell of the circulating blood. Further work is in progress.

These experiments offer further corroboration, if such be needed, of Miller's (23) explanation of the removal of inhaled foreign particles from the lung. Traced from week to week, and especially well shown in animals allowed to live some time after discontinuing the dust exposures, the course of these dust cells on their way out of the lung is quite evident. Gathered from the whole lung, they slowly collect in those alveoli along the course of the ductuli alveolares; gradually they move toward the lymphoid tissue at the distal end; and one by one the dust cells enter this first outpost of the drainage apparatus. The lymphoid tissue undergoes active hypertrophy and increases in size. A similar mobilization later occurs to the larger lymph nodules at the

bifurcation of the bronchioles and bronchi. Once within the lymphatic system, the dust is readily carried to the tracheobronchial lymph nodes. To generalize, the first mobilization is within the air spaces themselves; through these it is carried to the nearest lymphoid tissue. By way of these collections it gains access to the closed lymphatic vascular system which drains the lung, and through these vessels it is removed from the organ.

Such changes have been observed in animals exposed to granite dust for seven months. What may follow later remains to be demonstrated. Watkins-Pitchford (28) Haythorn (10), and others have stressed the choking of lymphatics by fibrous tissue, which surrounds and compresses these minute drainage paths. When such a change has occurred it is obvious that a vicious circle will be set in motion for the irritant can no longer be removed and a progressive fibrous lesion is the logical sequence. It is after such changes have occurred that, theoretically, the lung may be expected to show unusual reaction to the tubercle bacillus, both at the site of primary infection and in the ultimate distribution of lesions throughout the body.

The R1 strain of tubercle bacillus has been selected for infection of the animals, for clinical experience has shown that lesions due to granite dust are slow to develop and it is undesirable that the animals should die of infection before the dust has had opportunity to exert its full effect. In the words of Krause (13): "We have always looked upon R1 infected animals as affected with a self-limited, healing tuberculosis and more or less comparable to those human beings who are infected but whose infection shows no tendency to progress."

The course of the disease has been clearly demonstrated in the description of the lesions. It may be well to emphasize again, however, the fact that animals inoculated by the inhalation of this organism show a typical pulmonary tuberculosis such as we are accustomed to see in animals infected with other strains of tubercle bacilli. But instead of leading to the death of the animal recovery takes place and the lung is restored to function.

As before stated the experiments here reported deal only with the early changes encountered when animals are exposed to the influence of both dust and tubercle bacilli. It has been shown that when a guinea pig is infected by inhalation of the R1 strain of tubercle bacillus and is then exposed to granite dust during the course of the resultant infection, a definite alteration in the progress of this infection takes place. We

are dealing here with two foreign bodies introduced simultaneously into the air spaces of the lung. One is organic, capable of reproducing in kind, an agent which at first sets up changes, progressive and destructive; but after an interval varying from two to five months the process becomes regressive and ultimately disappears. The other irritant is inorganic and is only injurious to the lung when it has accumulated in very large amounts. It acts very slowly within the alveoli, for, as has been shown, guinea pigs may be exposed daily to rather heavy concentrations of such dust over a period of seven months, without serious damage to the lung tissue. Both irritants enter and leave the lung by the same path.

In the process of removal they are both collected in considerable quantities at certain definite locations, that is, about the smaller collections of lymphoid tissue in the peripheral third of the lung. The dust remains passive but the tubercle bacilli undergo further proliferation. By this process of concentration of both irritants within a small area injury is done the tissues at this point and lesion follows. As the result of these two influences, one of which tends to produce proliferation and the other of which tends to produce degeneration, a lesion arises which differs from both pure tubercle and from changes produced by dust alone. The proliferative-connective tissue reaction on the part of the lung is overstimulated by the dust and in consequence the tubercle shows an alteration in structure. It loses its characteristic zonal arrangement: connective tissue proliferation begins early, progresses further than in the simple tubercle, and tends to involve the adjoining alveolar walls. Instead of a compact sharply circumscribed tubercle there results a central solid mass with heavy radiating peripheral processes. Lymphoid infiltration is likewise not confined to the periphery of the lesion but is found irregularly spreading from the very edge of the caseous centre to the thickened walls of adjacent alveoli. Caseation is not apparently influenced.

This early and progressive fibrosis tends to retard the healing of the process so that large caseous tubercles in the dusted lung may persist for seven months and longer while in the undusted animal practically all traces of tubercle will have disappeared at this time.

As to the removal of these two irritants from the lung where each starts coincidently, the tubercle bacillus passes very early to the tracheobronchial lymph nodes and there sets up a readily detectable lesion. This is, of course, due to a further concentration of many living irritants, capable of rapid multiplication. The dust, however, is not

so readily detected and it has not the active power of multiplication. In dust control animals it is found at this location during the second month, but in those animals in which infection is also present none can be seen until the third month and it is not until the sixth or seventh month that any considerable amount can be detected. Whether this is due to the fact that the dust is obscured by the reaction to large numbers of tubercle bacilli or whether dust is actually retained in the lung by the tubercles at the points of exit, is problematical. However, careful study of the lesion, both in the lung and the lymph nodes, together with a comparison with the dust controls would seem to indicate that a large amount of dust is actually retained within the lung and that its removal is prevented by tubercles at the points of exit.

Although observations have been made only upon lungs previously dusted for a short period (three months) yet it may be positively asserted that the tubercles occurring in the lungs of such animals are larger and show more fibrosis than those in which the dust and infection are coincident. If the exposure to dust is discontinued after infection the process would probably undergo a slow absorption although all the animals of this series were killed at the height of the tubercle reaction. If the dust be continued after infection, fresh increments producing proliferative changes are gathered at the periphery of the tubercle. In each instance both tubercle bacilli and dust in small amounts still reach the tracheobronchial lymph nodes.

Thus it would seem that these two irritants, the tubercle bacillus and granite dust, acting together are capable in a short time of setting in motion a series of reactions on the part of the lung which neither alone is capable of initiating. By concentration of both in small foci each reinforces the action of the other, resulting in a chronic lesion which is slow to heal.

Whether the tubercle bacillus, acting not by its immediate presence but through some more remote mechanism, can aid the dust in stimulating the proliferation of fibroblasts is still uncertain. But it is tempting to surmise that the fibrous lesions, located probably in the position of small lymphoid collections, are of such origin. They bear only superficial resemblance to tubercles; they apparently contain no tubercle bacilli; and they are not found in dust controls at this stage. May they not be the "nodular fibroses" which are described in the later stages of pneumokoniosis which are thus early in the process of formation due to the combined action of the two irritants?

And what mechanism underlies this reënforcement of one irritant by the other? Undoubtedly Krause (16) is correct in his mechanical theory where dust exposure has continued for a long time previous to infection. But this study has shown that while fibrous changes are very slow to develop in animals exposed to dust alone, yet if infection be superimposed upon a very short preliminary dusting, an over abundance of fibrous tissue results and the course of the tuberculosis is materially changed. It must be evident that no "mechanical blocking of lymphatics" can have occurred to initiate a vicious circle at this early stage. Apparently this is not the whole story.

Nor does Haldane's (9) explanation seem to satisfy the equation. On the one side we have direct experimental proof that this dust is removed from the lungs, so that it probably contains those "juicy absorbent particles" which stimulate the migration of dust cells. On the other hand we have the clinical experience and the mortality statistics from Vermont which would tend to indicate the workers in this dust are prone to fibrosis of the lungs and perhaps to tuberculosis.

The third view, that of Cesa-Bianchi (2), who uses the term *locus minoris resistentiae* to "explain" the condition, is also of little help at the present time.

It would seem that some light might be thrown upon this unanswered question by studying the reaction of avascular scar tissue to tubercle bacilli. Such experiments are in process as well as a repetition of Cesa-Bianchi's experiments.

The only explanation which seems possible at this time is that already suggested; namely, that large amounts of each irritant seeking exit from the lung are brought together at a common focus; that the tubercle bacillus initiates not only a degenerative, but also a proliferative, fibrous reaction; and that the latter is enhanced by the granite dust which is in itself capable of stimulating a like change. Acting alone granite dust requires a much longer period for this reaction to occur but in the presence of the tubercle bacillus the reaction is greatly stimulated.

CONCLUSION

Under the conditions of this experiment where the R1 strain of tubercle bacillus has been used to infect guinea pigs by the inhalation method, coincidently and previously exposed to granite dust of a given concentration, it may be concluded:

1. That the occurrence of tubercles is more frequent in the dusted than in the undusted lung.

2. That such lesions tend to run a more prolonged course than those in animals not exposed to dust.

3. That the spread of the tuberculous process to the regional lymph nodes is not prevented.

My sincere acknowledgment and thanks are due to Dr. E. R. Baldwin for his aid in planning these experiments and many helpful suggestions. My acknowledgments are also due to Mr. James V. Luttrell who has perfected the dusting device now in use, and also to Mr. George C. Hulpritt for his careful preparation of the large number of sections necessitated by this experiment.

REFERENCES

(1) Arnold, J.: Untersuchungen über Staubinhalation und Staubmetastese. Leipzig, 1885.
(2) Cesa-Bianchi, D.: Zeitschr. f. Hyg. u. Infectkr., 1913, lxxiii, 166.
(3) Dale, T. N.: The granite of Vermont. U. S. G. S. Bull., 404.
(4) Collis, E. L.: Industrial pneumokonioses with special reference to dust phthisis. Milroy Lectures, 1915.
(5) Foot, N. C.: Jour. Med. Res., 1919, xl, 353.
(6) Foot, N. C.: Observations on the histogenesis of experimental tubercles in the lung of vitally stained rabbits. Read before the American Association of Pathologists and Bacteriologists, New York, 1920.
(7) Forbes, A.: Jour. Med. Res., 1909. xx, 45.
(8) Haldane, J. S., Martin, J. S., and Thomas, R. A.: Report to the Secretary of State for the Home Department on the Health of Cornish Miners. 1904. Scientific American Supplement, Aug. 24, 1918.
(9) Haldane, J. S.: Reprinted from Engineering Supplement of London Times, Scientific American Supplement, August 24, 1918.
(10) Haythorn, S. R.: Jour. Med. Res., 1913, xxix, 259.
(11) Hoffman, F. L.: Mortality from respiratory diseases in dusty trades. Bull. U. S. Dept. Labor Statistics, No. 231, Washington, June, 1918.
(12) Klotz, O.: Amer. Jour. Pub. Health, 1914, iv, 887.
(13) Krause, A. K.: Jour. Med. Res., 1916, xxxv, 1.
(14) Krause, A. K.: Amer. Rev. Tuberc., 1918, i, 717.
(15) Krause, A. K.: Ibid., 1919, iii, 1.
(16) Krause, A. K.: Personal communication.
(17) Mallory, F. B.: Jour. Exp. Med., 1898, iii, 612.
(18) Mallory, F. B.: The histology of the skin lesion in measles. Read before the American Association of Pathologists and Bacteriologists, New York, 1920.
(19) Mallory, F. B.: Principles of pathologic histology. Saunders, Phila., 1914.
(20) Mavrogordato, A.: Jour. Hyg., 1918, xvii, 439.
(21) Miller, W. S.: Amer. Rev. Tuberc., 1919, iii, 33.
(22) Miller, W. S.: Amer. Jour. Roentgen., 1917, iv, 269.
(23) Miller, W. S.: Anat. Record, 1911, v, 99.
(24) McJunkin, F. A.: Arch. Int. Med., 1918, xxi, 59.

(25) McJunkin, F. A.: An endothelial leucocytosis in guinea pigs by injection of saprophytic tubercle bacilli. Read before American Association of Pathologists and Bacteriologists, New York, 1920.

(26) Sewell, W. T.: Jour. Path. & Bact., 1918, xxii, 40.

(27) Tchistovitch, N.: Annales de l'Inst. Pasteur, 1889, iii, 337.

(28) Watkins-Pitchford, W.: Med. Jour. of So. Africa, 1914, ix, 196.

(29) General Report Miners' Phthisis Prevention Committee. Pretoria, South Africa, 1916.

AN ATTEMPT TO PRODUCE EXPERIMENTAL TUBERCULOUS PLEURAL EFFUSIONS AND EMPYEMAS IN RABBITS

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Tuberculous effusions and empyemas would well lend themselves to therapeusis provided it were possible to experimentally test out the proposed methods of treatment in a well-controlled manner. It is impossible to carry out such experiments on man, and in experimental animals where controls usually may be obtained there is available no method which can be relied upon to produce a replica of the condition found in man. Encouraging experiments were performed in 1917 by Paterson (1) on guinea pigs in which it was found that normal animals, given intrapleural inoculations of tubercle bacilli, developed no noticeable pleural reaction, while such injections in tuberculous guinea pigs resulted in the exudation of serum, leucocytes, red blood cells and fibrin. Paterson concluded from these experiments that clinical pleural effusions are caused by the infection of an allergic pleura. These experiments seemed to be based on a good firm foundation since the difference between the reaction of a normal and a tuberculous animal to the injection of tubercle bacilli had been noted early by Koch (2) and within recent years these differences were corroborated by Trudeau (3) and Krause (4) for the lungs, Soper (5) for the liver, and Römer and Joseph (6) and Corper (7) for the skin. Unfortunately, however, the guinea pig of the common available laboratory animals is too small for satisfactory experimentation, while the dog has a weak mediastinum so that gases or liquids injected on one side frequently pass to the other side producing a double pleural condition. For the experiments to be reported the rabbit was taken as the animal of choice, since it is of fair size and possesses a strong mediastinal veil, although reacting slightly differently from the guinea pig to infection, especially with human tubercle bacilli. In the latter respect, however, it seems to possess certain advantages over the guinea pig, in view of the fact that the human tubercle bacillus even if highly virulent for the guinea pig only produced a local

disease in the rabbit and, therefore, the same culture could be used both for preliminary sensitization and final intrapleural infection. Paterson used two different cultures of human tubercle bacilli (strain R1, slightly virulent, producing only local disease in the guinea pig, for sensitizing; and three weeks or more later strain H 37, highly virulent, intrapleurally) throughout his entire experiments.

The main purpose of this investigation when initiated was not to determine the factors instrumental in the production of tuberculous pleural effusions or empyemas but to develop a method suitable for uniformly producing these conditions available for studying the effects of various therapeutic procedures.

The following experiments were performed in duplicate sets, each set consisting of 21 rabbits, full grown Flemish hares, weighing from 7 to 10 pounds each. Seven of these served as controls, receiving no sensitizing injection of tubercle bacilli; seven received a subcutaneous injection of 1 mgm. of virulent human tubercle bacilli No. 1851; while the remaining seven were sensitized by the intravenous injection of 0.2 mgm. of culture no. 1851, resulting in a pulmonary miliary infection. The latter set was chosen because this seemed more nearly to approximate the condition in man, in whom an effusion or empyema is usually associated with some pulmonary disease. One month after the sensitizing injection, an interval allowing good primary tubercle development which seems to be essential for a good secondary reaction, the entire set was given an intrapleural injection of 50 cc. of 7 per cent saline acacia,[1] containing about 3 mgm. of a good uniform suspension (8) of the same culture of virulent human tubercle bacilli, no. 1851, used for sensitizing. The rabbits were killed in groups of three, including one control, one subcutaneously sensitized and one intravenously sensitized, four days, eight days, two weeks, three weeks and four weeks after the final intrapleural injection. Some of the animals died of snuffles during this time; but these are not included in the series, since snuffles usually complicates the findings to such an extent that the data are valueless, and for this reason only animals that appeared healthy and were free from intercurrent disease when killed are recorded.

[1] The saline acacia was prepared by making a 7 per cent solution of gum acacia in 0.9 per cent sodium chloride solution and sterilizing it by autoclaving. See Bayliss, W. M.: *Jour. Pharmacol. & Exper. Therap.*, 1920, xv, 29.

EXPERIMENTAL DATA

Findings four days after the intrapleural injection of tubercle bacilli:

Control rabbit, N. 1.[2] There are 3 cc. of clear yellow fluid in the right pleural cavity and 1 cc. in the left. The tubercle bacilli are found clumped at the apex of the right lung anteriorly and on the parietal pleura posterior to the sternum.

Subcutaneously sensitized, S. 1. There are 4 cc. of clear yellow fluid in the right pleural cavity and none in the left. The tubercle bacilli are found in clumps at the apex of the right lung and on the parietal pleura and mediastinum. There are a few very small tubercles in both lungs. The local primarly lesion in the left abdominal wall is about 1.5 cm. in diameter.

Intravenously sensitized, I. 1. There is no fluid in either pleural cavity and large miliary tubercles are found throughout both lungs. The tubercle bacilli injected intrapleurally are found in clumps anteriorly at the apex, on the mediastinum, the sternal parietal pleura and in the interlobar fissure.

Findings eight days after the intrapleural injection of tubercle bacilli:

Control rabbit, N. 2. No fluid is found in either pleural cavity. Tubercle bacilli in clumps are present about the hilum of the right lung and on the posterior surface of the sternum; otherwise the animal is negative.

Subcutaneously sensitized, S. 2. No fluid is found in either pleural cavity. Tubercle bacilli are present in clumps anteriorly toward the apex, around the hilum of the right lung, and on the sternal surface of the parietal pleura. At the local primary site of injection there is a caseous nodule about 1.2 cm. in diameter. The remaining findings are negative.

Intravenously sensitized, I. 2. No fluid is found in either pleural cavity. Tubercle bacilli are present in clumps anteriorly on the parietal pleura on the right side. There are adhesions at the apex of the right lung. Both lungs are full of large miliary tubercles.

Findings two weeks after the intrapleural injection of tubercle bacilli:

Control rabbit, N. 3. No fluid is found in either pleural cavity. The tubercles are massed around the apex, along the posterior sternum on the right side and at the base of the heart, otherwise the animal is negative.

Subcutaneously sensitized, S. 3. No fluid was found in either pleural cavity. The tubercles are located around the hilum, on the anterior surface of the right lung, and on the posterior surface of the sternum. There are a few adhesions at the apex. At the local primary site of injection a caseous nodule about 2 cm. in diameter is found. A few tubercles were found in the lungs. The remaining findings are negative.

[2] These animal number notations are arbitrary and are merely given for simplifying the recording of these experiments, not being the original experimental numbers of the animals.

Intravenously sensitized, I. 3. No fluid is present in either pleural cavity. There are large miliary tubercles throughout both lungs, and clusters of tubercles on the right posterior surface of the sternum and at the anterior part of the right apex. The pleural surfaces otherwise are smooth and glistening.

Findings three weeks after the intrapleural injection of tubercle bacilli:

Control Rabbit, N. 4. No fluid is present in either pleural cavity. The tubercles are clustered on the posterior right sternal suface and on the anterior margins of the right lung. There is also a cluster of tubercles on the parietal pleural surface at the original site of intrapleural injection. Otherwise the animal is negative.

Subcutaneously sensitized, S. 4. There is no fluid present in either pleural cavity. The tubercles are clustered on the right posterior sternal pleura, along the anterior mediastinum, and on the anterior surface of the right lung. There are a few tubercles on the mediastinal part of the diaphragm; otherwise the pleura is smooth and glistening. At the local primary site of injection there is a tubercle about 1 cm. in diameter. The remainder of the animal is normal.

Intravenously sensitized, I. 4. There is no fluid present in either pleural cavity. There are distinct large miliary tubercles throughout both lungs. The tubercles are mainly located along the right posterior sternal surface and a few are found along the anterior margins of the right lung and right pulmonary hilum. The pleural surfaces otherwise are smooth and glistening.

Findings four weeks after the intrapleural injection of tubercle bacilli:

Control rabbit, N. 5. There is no fluid present in either pleural cavity. The tubercles are clustered along the right sternal parietal pleura, on the anterior and mediastinal surfaces of the right lung, and a few are found along the pleural surface of the right diaphragm. The rest of the animal is negative.

Subcutaneously sensitized, S. 5. Resembles control rabbit, N. 5, except for a slight variation in the distribution of the pleural tubercles. The local primary site of injection consists of a caseous nodule about 1 cm. in diameter.

Intravenously sensitized, I. 5. There is no fluid present in either pleural cavity. There are distinct miliary tubercles in both lungs. With slight variations the pleural tubercles are located along the right sternum, the anterior surfaces of the right lung and the hilum of the right lung. The pleural surfaces are smooth and glistening.

As nearly as repetition is possible with experimental animals the above series has been duplicated; but the report of this series is not included, since it did not differ materially in the general findings and would therefore not add anything to the above report. From these two series of experiments performed at different intervals the following conclusions seem justified:

1. That virulent human tubercle bacilli in fine suspension in gum saline (seven per cent acacia in physiological saline) solution injected intrapleurally on the right side into normal rabbits tend to clump and form clusters of tubercles especially toward the lower or anterior portions of the right pleural cavity and on the right lung and toward the mediastinum.

2. That there does not seem to be any difference in the gross final results of the intrapleural injection of the living virulent human tubercle bacilli, regardless of whether the rabbits have received either a subcutaneous or an intravenous (sensitizing) injection of the same culture.

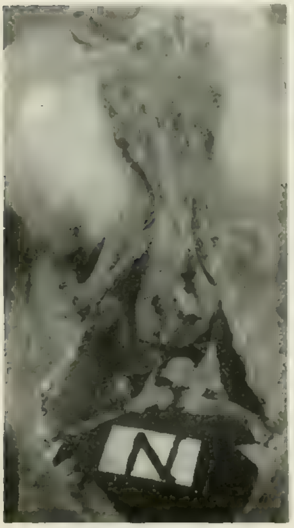

Fig. 1

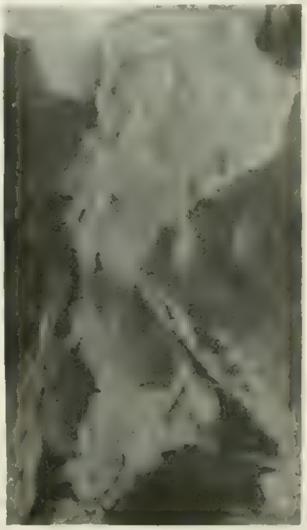

Fig. 2

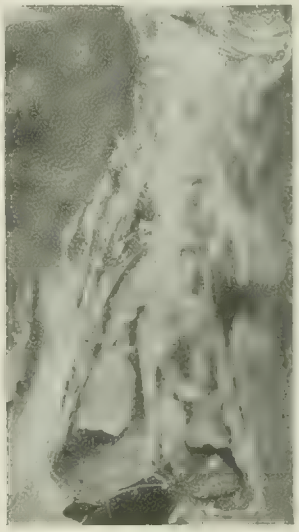

Fig. 3

Fig. 1. Result of Intrapleural Injection of Virulent Human Tubercle Bacilli into a Normal Rabbit (Front view)

Note the irregular distribution and clumping of the tubercles three weeks after inoculation

Fig. 2. Result of Intrapleural Injection of Tubercle Bacilli into a Rabbit Previously Injected Subcutaneously with the Same Culture of Tubercle Bacilli (Front view)

Note the irregular distribution of the tubercles along the anterior lung surface and the sternum.

Fig. 3. Result of Intrapleural Injection of Tubercle Bacilli into a Rabbit Previously Given an Intravenous Injection of the Same Bacilli (Front view)

Note the irregular distribution of tubercles on the right side and the miliary tubercles in both lungs.

one month prior to the intrapleural injection. The finer histologic tubercle differences were not studied.

3. That in rabbits there is no more tendency to form pleural effusions or an empyema following the intrapleural injection of virulent (for guinea pigs) human tubercle bacilli in those animals having received either a subcutaneous or an intravenous injection of the same culture of tubercle bacilli one month prior to the intrapleural injection than in a normal rabbit not having received such preliminary sensitizing injection, thus making it impracticable to use this method in the rabbit for the production of tuberculous effusions or empyemas for experimental therapeutic or other studies.

Fig. 4

Fig. 5

Fig. 4. Result of Intrapleural Injection of Virulent Human Tubercle Bacilli into a Normal Rabbit Four Weeks after Infection (Side view)

Note the irregular distribution of the tubercles

Fig. 5. Result of Intrapleural Injection of Tubercle Bacilli into a Rabbit Previously Injected Intravenously with the Same Culture of Tubercle Bacilli (Side view)

Note the irregular distribution of the tubercles and the presence of miliary tubercles

REFERENCES

(1) Paterson, R. C.: Amer. Rev. Tuberc., 1917, i, 353.
(2) Koch, R.: Deutsch. med. Wchnschr., 1891, xvii, 101.
(3) Trudeau, E. L.: New York M. J., 1903, lxxviii, 105.
(4) Krause, A. K.: Nat'l. Assoc. Study & Prev. Tuberc. Tr., 12th annual meeting, 1916, 243.
(5) Soper, W. B.: Amer. Rev. Tuberc., 1917, i, 385.
(6) Römer, P., and Joseph, K.: Beitr. z. Klin. d. Tuberk., 1910, xvii, 287.
(7) Corper, H. J.: Amer. Rev. Tuberc., 1917, i, 407.
(8) Corper, H. J.: Jour. Inf. Dis., 1918, xxiii, 500.

THE EFFECT OF PROLONGED PNEUMOTHORAX UPON TUBERCULOSIS OF THE LUNGS OF RABBITS, FOLLOWING THE INTRAVENOUS INJECTION OF TUBERCLE BACILLI

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It is rather singular that with the innumerable publications on artificial pneumothorax, there should have been practically no experimental laboratory observations made on the effect of this procedure upon pulmonary tuberculosis in animals until in 1919, when Shaw (1) reported rather scanty observations on rabbits, from which he concluded that artificial compression led to a greater tuberculous involvement of the collapsed than of the noncollapsed lung. If these observations were authentic and borne out in man, the use of artificial pneumothorax as a therapeutic procedure might certainly appear open to condemnation. In a previous paper by Corper, Simon and Rensch (2), the observations made by Shaw could not be corroborated. In a large series of well-controlled rabbits it was found that one sided artificial pneumothorax, or compression of one of the lungs by means of fluid (artificial hydrothorax), had no visible macroscopic influence upon the number or type of the tuberculous lesions resulting from the intravenous injection of virulent human tubercle bacilli, regardless of whether the compression was made on the right or left side, or a day before or a day after the intravenous injection of the tubercle bacilli. There was also noted no differences between the number or type of the tuberculous lesions in animals with one lung compressed as compared to normal noncompressed animals, although the differences between the different animals of the same series receiving the same intravenous injections of tubercle bacilli were greater than the differences found between the two lungs of the same animal. In these previous experiments which aimed mainly to repeat and attempt to corroborate Shaw's work, the artificial pneumothorax was not maintained for a sufficiently long time, to be entirely convincing as to whether this procedure might not have some effect, possibly beneficial, upon the

tuberculosis in the lungs. It therefore seemed desirable to extend the time period of the tests as far as was consistent with the life of the experimental animal used. The following experiments were planned for this purpose as an addendum to the previous contribution.

This experiment included 16 rabbits: 6 controls given an intravenous injection of a uniform emulsion (3), containing 0.2 mgm. of a culture no. 1851 of virulent human tubercle bacilli in 1 cc. of 0.9 per cent sodium chloride solution, and 10 rabbits similarly injected with tubercle bacilli and shortly thereafter given an intrapleural injection of air on the right side, after which the compression was maintained by injecting air into the right pleura at intervals of two to three days throughout the entire period of experimentation as detailed in the following protocols. Of the 6 control rabbits, 5 survived the entire experimental period; while of the 10 pneumothorax rabbits, 5 survived. Only the findings on the 5 controls and 5 pneumothorax rabbits surviving the entire interval are recorded.

Control rabbits receiving only tubercle bacilli intravenously. The entire series, controls and pneumothorax rabbits, were killed one month after the injection of the tubercle bacilli and the initiation of the artificial pneumothorax.

Control rabbit no. 1. At postmortem revealed a uniformly distributed miliary tuberculosis of both lungs, the tubercles being about 0.5 to 1.5 mm. in diameter.

Control rabbit no. 2. Upon section both lungs were uniformly involved by a miliary tuberculosis, the tubercles being about 0.5 to 1.0 mm. in diameter.

Control rabbit no. 3. Upon section this rabbit revealed a uniformly distributed miliary tuberculosis of both lungs, with tubercles ranging from 0.5 to 1.5 mm. in diameter.

Control rabbit no. 4. Practically a duplicate in distribution and findings to rabbit no. 3.

Control rabbit no 5. Practically a duplicate in pulmonary findings to rabbit no. 2.

Pneumothorax rabbit no. 1. On section revealed a uniform distribution of miliary tubercles about 0.5 to 1 mm. in diameter throughout both lungs. The right lung was well collapsed.

DAY OF EXPERIMENT	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
Before injection		0.0 to −2.0
1	50	+0.5 to −0.0
3	50	+0.5 to −0.0
5	100	+0.5 to −0.0
7	75	+0.5 to −0.5
9	50	+1.0 to −0.0
12	50	+0.5 to −0.0
14	50	+0.5 to −0.0
17	75	No reading
21	Before	+0.0 to −1.0
	After 50	+1.0 to −0.0
24	Before	+0.0 to −1.0
	After 50	+2.0 to +0.5
26	75	+1.5 to −0.5
29	75	+1.5 to −0.0

Pneumothorax rabbit no. 2. At postmortem revealed findings not differing greatly from those of rabbit no. 1. The right lung was well collapsed.

DAY OF EXPERIMENT	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	50	No reading
3	50	+0.5 to −0.5
5	75	+1.0 to −0.0
7	75	+1.0 to −0.0
9	85	+0.5 to −0.5
12	75	+0.5 to −0.0
14	75	+1.0 to −0.0
17	80	+1.0 to −0.0
21	50	+1.5 to −0.0
24	50	+0.5 to −0.0
26	Before	+0.0 to −1.0
	After 50	+1.5 to −0.0
29	Before	+0.0 to −1.0
	After 50	+0.5 to −0.0

Pneumothorax Rabbit no. 3. On section there was found a uniform distribution of miliary tubercles from 0.5 to 1.5 mm. in diameter throughout both lungs. The right lung was well collapsed.

DAY OF EXPERIMENT	AIR INJECTED.	WATER MANOMETER READING
	cc.	*cm.*
1	50	+0.5 to −0.0
3	50	+1.0 to −0.0
5	50	+2.0 to +1.5
7	75	No reading
9	75	+2.0 to +1.0
12	50	+0.5 to −0.0
14	50	+0.5 to −0.0
17	50	+0.5 to −0.0
21	75	+2.0 to −0.0
24	45	+1.0 to −0.0
26	50	+1.0 to −0.0
29	60	+1.0 to −0.0

Pneumothorax rabbit no. 4. Postmortem revealed a uniformly distributed miliary tuberculosis throughout both lungs the tubercles ranging in diameter from 0.5 to 1.5 mm. The right lung was well collapsed, the middle lobe being entirely consolidated (not a tuberculous bronchopneumonia).

DAY OF EXPERIMENT	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	50	+0.5 to −1.0
3	50	+0.5 to −0.5
5	75	+0.5 to −0.5
7	75	+1.0 to −0.5
9	75	+2.0 to +0.5
12	75	+1.0 to −0.0
14	75	+1.0 to −0.0
17	75	+1.5 to −0.0
21	100	+1.5 to −0.0
24	75	+1.0 to −0.0
26	75	+1.0 to −0.0
29	65	+1.0 to −0.0

Control rabbit no. 5. On section revealed a fairly uniform distribution of miliary tubercles throughout both lungs, ranging from 0.5 to 1 mm. in diameter. The right lung was well collapsed.

DAY OF EXPERIMENT	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	50	+0.5 to −0.0
3	50	+1.0 to −0.0
5	50	+1.5 to −0.0
7	75	+1.5 to +0.5
9	75	+1.0 to −0.0
12	75	+1.5 to +0.5
14	75	+1.0 to −0.0
17	75	+1.0 to −0.0
21	100	+1.5 to +0.5
24	75	+1.0 to −0.0
26	75	+1.5 to −0.5
29	75	+1.0 to −0.0

On account of the uniformity obtained in these findings, there being no appreciable gross macroscopic differences between the lungs of the pneumothorax and tuberculous nontreated rabbits, a photograph is given of the lungs of only one typical control and one typical pneumothorax rabbit (see figs. 1 and 2). For the sake of preservation and of uniformity in photography, both of these lungs have been inflated by tying the trachea and injecting into it about 20 cc. of a 20 per cent glycerol, 20 per cent formaldehyde mixture. The specimen on the left side (larger appearing) in the photograph was obtained from the pneumothorax rabbit. Note the uniformity in number and size of the small tubercles in both the right and left lung. The specimen on the right side in the photograph was taken from the untreated rabbit. Note the uniformity of the distribution and size of the miliary tubercles in both lungs, right and left, and the striking similarity in number and size of these miliary tubercles to those in the lungs (left side specimen of photograph) from the treated animal.

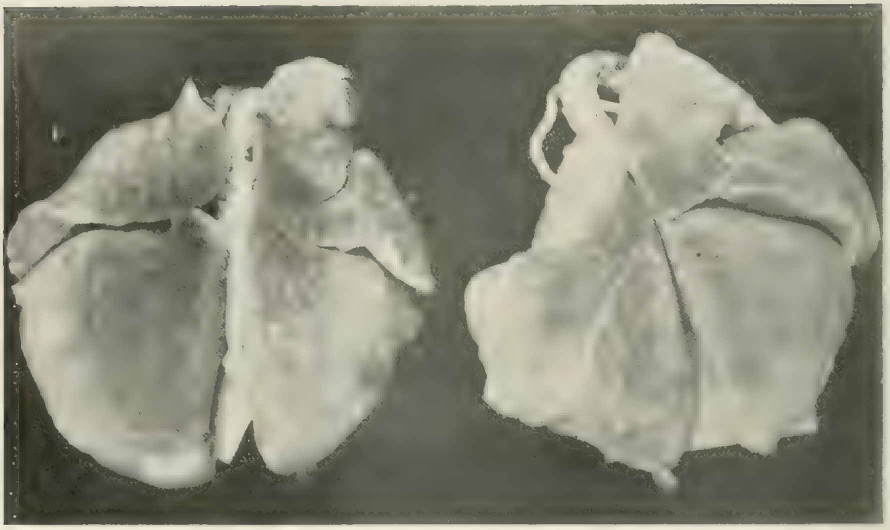

FIG. 1 FIG. 2

FIG. 1. PNEUMOTHORAX RABBIT

Pneumothorax induced on right side and continued for one month.

FIG. 2. NORMAL RABBIT

Note the uniformity in both size and distribution of the miliary tubercles in both animals and in both lungs of each animal.

SUMMARY AND CONCLUSIONS

Prolonged artificial pneumothorax in rabbits sufficient to induce a good collapse of the right lung, initiated shortly after the intravenous injection of a suspension of virulent human tubercle bacilli and maintained for a period of a month by means of the intrapleural injection of air every second or third day throughout the experimental period, has no appreciable effect upon the size or number of macroscopic tubercles found in the lungs of the treated animals as compared to the untreated, or in the compressed right lung as compared to the noncollapsed left lung.

REFERENCES

(1) SHAW, F. W.: Amer. Rev. Tuberc., 1919, iii, 410.
(2) CORPER, H. J., SIMON, S., AND RENSCH, O. B.: Ibid., 1920, iv, 592.
(3) CORPER, H. J.: Journ. Inf. Dis., 1918, xxiii, 500.

THE PULMONARY DISTRIBUTION OF FINELY DIVIDED SUSPENSIONS INJECTED INTRAVENOUSLY INTO RABBITS AFTER THE PRODUCTION OF ARTIFICIAL PNEUMOTHORAX

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In a previous communication by Corper, Simon and Rensch (1), on the effect of artificial pneumothorax upon experimental pulmonary tuberculosis in the rabbit, there were reported a few experiments performed for the purpose of obtaining information on the observation made that the tubercles in the lungs resulting from the intravenous injection of a uniform suspension of virulent human tubercle bacilli were equally distributed in both lungs, regardless of whether one of the lungs had been compressed a day before or a day after the injection of the bacilli. It seemed that compression of a lung before the injection should have had an effect upon the pulmonary circulation and thus result in an altered distribution of the tubercles in the two lungs. In order to eliminate the time interval necessary for the development of the pulmonary tubercles resulting from the intravenous injection of the tubercle bacilli, suspensions of Prussian blue, scarlet R and starch were used for the intravenous injection and the injections were given within one-half hour after a good compression of the lung. The Prussian blue precipitate was used because it imparted an immediate blue color to the lung and allowed an approximate color comparison of the compressed and normal lung, thus bringing out any gross differences in the distribution of the injected particles. The scarlet R suspension did not impart a color to the lungs but was well suited for accurate quantitative chemical analysis, while the starch could be tinted blue by immersion in a weak iodine solution. The latter proved to be least suited for the purpose at hand. These substances were found to be uniformly distributed in both lungs, similar to the tubercles resulting from the intravenous injection of tubercle bacilli, regardless of whether the lung was compressed before injection or not. It was also noted that the Prussian blue gradually and uniformly disappeared from both the compressed and normal lungs.

These experiments, having been performed immediately following compression, did not give any information regarding such changes as may occur after artificial pneumothorax had been maintained for a long period of time and it is for this reason that the following experiments were performed. This question was also raised by Dr. E. R. Baldwin in a personal interview with one of us who suggested that the following experiments should materially increase the value of these investigations.

In the following experiments compression of the right lung was maintained over periods of two and four weeks before the injection of the suspensions of Prussian blue and scarlet R into the circulation.

The compression was obtained by means of air using the usual Floyd-Robinson pneumothorax apparatus. The gas was injected every two or three days, starting with small amounts of about 50 to 100 cc., depending upon the size of the animal, in order to obtain a gradual compression. If too much gas was given at the beginning the mortality among the rabbits thus treated was very high. Even with gradual and slow compression it was possible only to maintain about one-half of the rabbits for a month for the final distribution test. The Prussian blue was prepared from ferric chloride and potassium ferrocyanide as described in the previous article (loc. cit.), while the scarlet R suspension was prepared by adding about one-twentieth volume of a strong ether solution of scarlet R to a 0.9 per cent sodium chloride = 7 per cent gum acacia solution (2) and shaking vigorously for about five minutes, when the scarlet R is found precipitated in a fine brown suspension in the gum acacia solution. The scarlet R remains suspended in this solution without preceptible settling for about eight to twenty-four hours.

THE DISTRIBUTION OF SCARLET R SUSPENSION INJECTED INTRAVENOUSLY IN THE LUNGS OF NORMAL RABBITS AND IN THOSE WITH A RIGHT-SIDED PNEUMOTHORAX MAINTAINED FOR TWO AND FOUR WEEKS

For the sake of comparison and as a control to this experiment five normal rabbits were given an intravenous injection of 5 cc. of 7 per cent gum acacia-saline solution, containing 0.64 mgm. of scarlet R (Grübler) in fine suspension. These rabbits were then killed at intervals of ten minutes, one and four hours and one and two days, when their lungs were removed, weighed individually and extracted by means of warm 95 per cent ethyl alcohol. The total alcoholic extracts were filtered,

diluted to a definite volume and the amount of scarlet R present determined colorimetrically by comparison with a standard known scarlet R solution in 95 per cent alcohol, using for this purpose the Kober colorimeter. Likewise, a series of five rabbits (the survivors from an initial twelve) in which the right lung had been maintained collapsed over a period of two weeks was given single intravenous injections of 5 cc. of the same suspension of scarlet R (containing 0.64 mgm.). These animals were killed at intervals of thirty minutes, one and four hours, and one and two days when their lungs were removed and analyzed for scarlet R colorimetrically.

The detailed accounts of the pneumothorax set of rabbits were as follows:

Thirty minute rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	125	+2.0 to +1.0
3	75	+2 0 to +0.5
5	75	+2.0 to +0.5
7	50	+2.0 to +0.5
10	100	+1.0 to +0.0
14	50	+1.0 to +0.5

Postmortem revealed a well collapsed right lung.

One hour rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	150	+2.0 to +1.0
3	75	+2.5 to +1.0
5	100	+1.0 to +0.5
7	100	+1.0 to −0.0
10	100	+1.0 to −0.0
14	50	+1.0 to −0.0

Postmortem revealed a well collapsed right lung.

Four hour rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	125	+1.0 to −0.0
3	75	+2.0 to +0.5
5	75	+2.0 to +0.5
7	75	+2.0 to +0.5
10	100	+1.0 to −0.0
14	50	+1.0 to −0.0

Postmortem showed a good collapse of the right lung.

One day rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	100	+2.0 to +1.0
3	75	+2.5 to +2.0
5	100	+1.5 to +0.5
7	75	+1.0 to −0.0
10	100	+1.0 to −0.0
14	75	+1.0 to −0.0

Postmortem examintion revealed a good collapse of the right lung with a bronchopneumonic consolidation of the middle lobe.

Two day rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	125	+2.5 to +1.5
3	50	+3.0 to +2.0
5	75	+1.0 to −0.0
7	60	+1.5 to −0.0
10	125	+1.5 to −0.0
14	50	+1.0 to −0.0

Postmortem revealed a well collapsed right lung.

The results of the analysis for scarlet R and the weights of the lungs are given in table 1 for the normal rabbits, and in table 2 for those with the right lung compressed two weeks, and table 3 for those compressed four weeks:

TABLE 1

Distribution of a suspension of scarlet R in the lungs of normal rabbits after intravenous injection

INTERVAL AFTER THE INJECTION OF SCARLET R	RIGHT LUNG			LEFT LUNG		
	Total moist weight	Scarlet R present		Total moist weight	Scarlet R present	
		Total	Per gram of lung		Total	Per gram of lung
		mgm.	*mgm.*		*mgm.*	*mgm.*
10 minutes	7.10	0.113	0.016	5.05	0.070	0.014
1 hour	6.80	0.098	0.014	4.40	0.069	0.016
4 hours	9.05	0.071	0.008	6.15	0.095	0.015
1 day	6.75	0.057	0.009	4.65	0.071	0.015
2 days	6.30	0.064	0.010	4.75	0.049	0.011
Average	7.20	0.081	0.011	5.00	0.071	0.014

It is to be noted after examination of table 1 that scarlet R particles do not readily disappear from the lungs following intravenous injection into normal rabbits and that there is a considerable range of variation between the distribution in the lungs of the various animals, so that only by averaging the findings in a series of animals is the approximate relative distribution between the right and left lungs obtained. In total average the right lung seems to retain more of the scarlet R particles, while on the basis of average per gram weight of moist lung tissue the left lung retains more in the approximate proportion of 11 for the right to 14 for the left.

TABLE 2

Distribution of a suspension of scarlet R, following intravenous injection in the lungs of rabbits with a right-sided pneumothorax maintained for two weeks

INTERVAL AFTER THE INJECTION OF SCARLET R	RIGHT LUNG			LEFT LUNG		
	Total moist weight	Scarlet R present		Total moist weight	Scarlet R present	
		Total	Per gram of lung		Total	Per gram of lung
		mgm.	*mgm.*		*mgm.*	*mgm.*
30 minutes	5.59	0.120	0.022	4.50	0.140	0.031
1 hour	8.10	0.072	0.009	11.15	0.070	0.006
4 hours	7.30	0.091	0.013	5.30	0.134	0.025
1 day	5.35*	0.084	0.016	6.20	0.093	0.015
2 days	8.35	0.064	0.008	7.35	0.074	0.010
Average	6.94	0.086	0.013	6.90	0.102	0.017

* This lung had a pneumonic consolidated middle lobe which weighed 2.3 grams and contained no scarlet R. This lobe was not included in the weight of the right lung or in the final average total moist weight figure.

An examination of table 2 reveals that there is not a marked difference between the distribution of the scarlet R suspension in the lungs after two weeks compression as compared to the normal lungs in table 1. The lower average total milligrams of scarlet R in the right lung may be considered a slight effect, but when the figures are viewed from the standpoint of the average milligrams scarlet R per gram of lung the proportion 13 for the right lung as compared to 17 for the left lung is about the same proportion as that noted in the normal animals.

The detailed accounts of the pneumothorax group of rabbits maintained for four weeks were as follows:

Thirty minute rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	75	+1.0 to −0.5
3	100	No reading
6	100	+1.0 to +0.5
8	100	+1.0 to −0.0
11	75	+1.0 to −0.5
14	75	+0.5 to −0.5
18	75	+1.0 to −0.0
22	75	+1.0 to −0.0
26	75	+1.0 to −0.0
29	75	+1.0 to −0.0

Postmortem revealed a well collapsed right lung.

One hour rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	50	No reading
3	100	No reading
6	100	+1.0 to −0.0
8	75	+1.0 to −0.0
11	100	No reading
14	75	+0.5 to −0.0
18	50	+1.0 to −0.0
22	100	+0.5 to −0.0
26	75	+1.0 to −0.0
29	75	+1.0 to −0.0

A well collapsed right lung was found on section.

Four hour rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	*cm.*
1	50	+1.0 to −0.5
3	100	+1.0 to −0.0
6	100	+1.0 to −0.0
8	100	+0.5 to −0.0
11	75	+0.5 to −0.5
14	75	+1.0 to −0.0
18	75	+1.5 to −0.0
22	75	+0.5 to −0.0
26	75	+1.0 to −0.0
29	75	+1.0 to −0.0

Good compression of the right lung was found at postmortem.

One day rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	cm.
1	50	+0.5 to −0.0
3	100	+1.0 to −0.0
6	100	+1.5 to −0.0
8	100	+1.0 to −0.0
11	100	+2.0 to −1.0
14	75	+1.0 to −0.0
18	75	+2.0 to +0.5
22	80	+1.5 to −0.0
26	75	+2.0 to +1.0
29	75	+1.5 to +0.5

Good compression of the right lung found on section.

Two day rabbit

DAYS	AIR INJECTED	WATER MANOMETER READING
	cc.	cm.
1	50	+1.5 to −0.5
3	100	No reading
6	100	+1.0 to −0.0
8	75	+1.5 to −0.0
11	100	+0.5 to −0.0
14	75	+1.0 to −0.0
18	75	+0.5 to −0.5
22	80	+0.5 to −0.0
26	75	+1.5 to −0.0
29	75	+1.0 to −0.0

The right lung was found well collapsed at postmortem.

These rabbits were injected at a different time than those reported above in tables 1 and 2, receiving a newly made suspension of scarlet R, each rabbit receiving 6 cc. of 7 per cent gum acacia in saline solution intravenously, containing 0.78 mgm. of scarlet R. The series when begun consisted of 12 rabbits, of which 6 survived the four weeks for the intravenous injection and analysis. The results of the analysis of the 5 found suitable for this purpose are given in table 3.

An examination of table 3 reveals that there is an appreciable difference between the amount of scarlet R found in the average per gram of lung after four weeks of collapse as compared to the average per gram of noncollapsed left lung, the proportion right collapsed 14 to left noncollapsed 29 differing distinctly from the findings in the untreated rab-

TABLE 3

Distribution of a suspension of scarlet R, after intravenous injection, in the lungs of rabbits with a right-sided pneumothorax maintained for four weeks

INTERVAL AFTER THE INJECTION OF SCARLET R	RIGHT LUNG			LEFT LUNG		
	Total moist weight	Scarlet R present		Total moist weight	Scarlet R present	
		Total	Per gram of lung		Total	Per gram of lung
		mgm.	*mgm.*		*mgm.*	*mgm.*
30 minutes	5.80	0.209	0.036	4.65	0.219	0.047
1 hour	10.15	0.056	0.005	6.80	0.172	0.025
4 hours	11.2	0.048	0.004	6.25	0.185	0.029
1 day	8.4	0.051	0.006	6.80	0.100	0.015
2 days	7.1	0.143	0.020	5.20	0.153	0.029
Average	8.53	0.101	0.014	5.90	0.166	0.029

bits, right collapsed 11 to left 14, or those only collapsed for two weeks, right collapsed 13 to left noncollapsed 17. This difference is also noted in the average total milligrams of scarlet R in the entire right or left lung, the normal right to left being 81 to 71, whereas after two weeks pneumothorax it was 86 to 102 and after four weeks, 101 to 166.

It must be admitted, however, as is easily revealed by a careful examination of these tables that these changes though they occur in the average and therefore in the majority of the animals cannot always be applied as a hard and fast rule.

THE DISTRIBUTION OF PRUSSIAN BLUE SUSPENSION INJECTED INTRAVENOUSLY IN THE LUNGS OF RABBITS IMMEDIATELY AFTER RIGHT SIDED PNEUMOTHORAX AND AFTER PNEUMOTHORAX HAD BEEN MAINTAINED FOR FOUR WEEKS

The observations made on animals given an intravenous injection of Prussian blue are merely macroscopic and cannot be as accurate as those obtained with scarlet R. Very marked differences should, however, be discernible and they are especially valuable since the Prussian blue precipitate is slightly soluble in the blood and therefore allows observations on its disappearance which may also be taken as an approximate circulatory effect.

The data on the distribution and disappearance of the Prussian blue from the lungs after acute collapse were given in the previous paper but at that time no photographs were incorporated in the article so that

they are included preferably here, since comparison is then possible between the result of acute (one-half hour collapse before injection) as compared to chronic (four weeks of collapse before injection) reaction (see figures). Unfortunately black and white photography cannot depict the actual presence and absence of the blue pigment, but the figures illustrate well the fairly uniform and equal distribution of this pigment and its gradual disappearance from both lungs, regardless of collapse. Only four lungs are pictured for each set since they give practically all the information desired, which could not be appreciably improved upon by the addition of more pictures.

Since the detailed findings with Prussian blue after four weeks' compression did not differ materially from those recorded in table 2 of the former paper, reference to the charted findings in that paper will also apply to those obtained after prolonged (four weeks) pneumothorax. For visual comparison, however, the figures of four sets of lungs showing the distribution of the Prussian blue after different intervals following the intravenous injection of this pigment four weeks after the maintenance of artificial pneumothorax are given.

SUMMARY AND CONCLUSIONS

A fine suspension of scarlet R in gum acacia-saline injected intravenously into normal rabbits is distributed to the two lungs, but the amounts found in the right or left lung by accurate colorimetric analysis are subject to considerable variation in the individual rabbits, so that only by averaging the findings in a series of animals is the approximate distribution obtainable. Such an average reveals the entire right lung to possess more of the scarlet R suspension than the left in proportion of 81 to 71 while on the basis of per gram weight of lung tissue the proportion 11 right to 14 left holds.

Compression of the right lung by means of air (artificial pneumothorax) maintained for a period of two weeks, followed by the intravenous injection of a suspension of scarlet R, does not appreciably alter this average relation resulting from the examination of a series of rabbits, although a slight difference is appreciated, especially in comparing the total average lung weight (the proportion being right (compressed) 86 to left 102) while the average scarlet R per gram lung is unaltered (right (compressed) 13 to left 17). Artificial pneumothorax maintained for four weeks, however, reveals an appreciable average change, the scarlet

R present in the total average lung weight being less in the compressed than in the noncompressed lung (the proportion being right (compressed) 101 to left 166) while the average scarlet R present on the basis of per gram lung is also less in the right as compared to the findings in the normal animal (the proportion being right compressed 14 to left 29).

It is, however, to be noted that these changes, though they are perceptible in averaging a series of animals, are subject in individual cases to marked variations and may not hold true, the individual rabbit at times even after four weeks maintenance of pneumothorax revealing proportions well within the average normal findings.

These differences, following prolonged pneumothorax, between the compressed and noncompressed lungs are not marked enough to be discernible by the gross macroscopic findings with a pigment like Prussian blue which, injected intravenously, reveals a fairly uniform distribution even after four weeks duration of the pneumothorax in rabbits, and likewise a fairly uniform disappearance of this partially soluble blue pigment.

REFERENCES

(1) Corper, H. J., Simon, S., and Rensch, O. B.: Amer. Rev. Tuberc., 1920, iv, 592.
(2) Bayliss, W. M., J. Pharmacol. & Exp. Ther., 1920, xv, 29.

FIG. 1. THE DISTRIBUTION OF PRUSSIAN BLUE AND ITS DISAPPEARANCE AT CERTAIN INTERVALS FROM THE LUNGS IN RABBITS IN WHICH A RIGHT-SIDED ARTIFICIAL PNEUMOTHORAX WAS PRODUCED A SHORT TIME (30 MINUTES) PRIOR TO INTRAVENOUS INJECTION OF THE PIGMENT

Specimen 1 was obtained immediately after injection of Prussian blue.
Specimen 2, two minutes after injection.
Specimen 3, five minutes after injection.
Specimen 4, thirty minutes after injection.
Note the gradual and uniform disappearance of the dye and its uniform distribution.

1  2

3 4

Fig. 2 The Distribution of Prussian Blue and its Disappearance at Certain Intervals from the Lungs of Rabbits in Which a Right-Sided Pneumothorax Had Been Maintained for a Month Prior to Intravenous Injection of the Pigment

Specimen 1 was obtained immediately after injection of the Prussian blue.

Specimen 2, three minutes after injection.

Specimen 3, five minutes after injection.

Specimen 4, ten minutes after injection.

A gradual and uniform disappearance of the dye is to be noted, until in specimen 4 only a few discrete spots are still seen.

THE USE OF SODIUM MORRHUATE IN PULMONARY TUBERCULOSIS[1]

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One of the great hopes of all mankind is a specific for the cure of tuberculosis. Following the work of Ehrlich in his discovery of the arsenobenzol compound for the treatment of syphilis, the interest in the possibilities of chemotherapy as the source of actual remedial agents became reawakened. Innumerable chemical salts, chiefly of inorganic sources, have been tested and up to the present time all have been discarded as of no value.

In spite of the discouragements of the past, new preparations are being tried in the hope that one of them may be the cure of cures in the treatment of tuberculosis. With this thought in mind I used the sodium gynocardate 'A' salt as advised by Sir Leonard Rogers. As reported in a previous article (1) my results failed to show any value for this drug in the treatment of pulmonary tuberculosis.

Shortly after the publication of his work with the gynocardate salt, Rogers announced the placing on the market of a sodium salt of cod liver oil. Known as sodium morrhuate, it is described as a preparation made from cod liver oil by extracting the unsaturated fatty acids with ether and making a sodium salt of these. A 3 per cent solution in water of this salt is injected subcutaneously, intravenously or intramuscularly. The dosage advised is $\frac{1}{4}$ to 1 mil, injected two or three times a week.

Reactions somewhat similar to those following the use of tuberculin are described. Up to the present time there seems to be a divergence of opinion as to whether these reactions are beneficial to the patient or not. Yet a warning is given to use great caution in the use of sodium morrhuate lest harm be done to the patient.

Cod liver oil has been advocated as a remedy for tuberculosis for centuries. To-day many have discarded it, while others still prescribe it in the belief that it possesses a specific property which acts against

[1] Read before the Mississippi Valley Tuberculosis Conference, Duluth, Minnesota, September 3, 1920.

the tubercle bacillus. Just what this property may be is in dispute. Some ascribe it to an iodine content; others to the presence of phosphorus; while yet other men believe that its chief value is in the fatty element.

Rogers states (2) that if sodium morrhuate be given by mouth, the only result noted is a gain of weight. If given by the hypodermic method he quotes the following results as those obtained by Muir of the Kulna Mission Hospital of India: (1) a rapid diminution in the amount of sputum, (2) a rapid taking on of weight, (3) a diminution of fever, (4) an increase of strength, and (5) a diminution or a total disappearance of tubercle bacilli from the sputum.

Rogers concludes his article with the following statement, "I am not satisfied that the drug is a specific cure for tuberculosis. I am however certain that at the present time it is the best line of treatment for tuberculosis in general." Captain P. Ganguili (3) has reported on 38 cases and gives as his results a similar report to that of Rogers.

With these enthusiastic reports before me, I had Smith, Stanistreet and Company of Calcutta, India, send me a supply of sodium morrhuate. This was prepared according to the directions of Rogers. A 3 per cent solution in sterile water with 0.5 per cent phenol was made. Placed in a sterile bottle and sealed with a rubber cap, the product was then again sterilized in an autoclave. An inital dose of $\frac{1}{8}$ mil was given subcutaneously. This dose was increased by $\frac{1}{8}$ mil in semiweekly injections until a dose of 1 mil was reached. Then only a single injection was given each week.

Twenty-five patients were placed under treatment. Eight were classified as incipient and the remainder as moderately advanced. All with one exception had tubercle bacilli in their sputum. A total of 430 injections were given. As in the previous work with the sodium gynocardate, the patient was not told that a new form of treatment for his disease was being used. The average time that each patient was under treatment with sodium morrhuate was slightly over four months. In addition to the drug each patient received the usual routine of sanatorium care.

1. We failed to notice any rapid diminution in the amount of sputum: at least any such change as might not be termed as normal for a patient under the usual treatment, and also taking in consideration the length of stay in the institution. It was noted that in four patients the sputum previously positive became negative and remained so during the remainder of their stay in the sanatorium, and that in three patients the sputum

became negative only to become again positive in spite of the fact that sodium morrhuate was being administrated at regular intervals. In fifteen patients the sputum remained positive throughout the entire course of treatment. In two patients the sputum became bacilli free, followed by their reappearance and again their disappearance. It was a strange coincidence that the only negative case injected became positive while being given the injections.

2. The average gain in weight was not greater than the average of patients equally ill and yet not under this special treatment.

3. The drug did not seem to have any beneficial action on the reduction of temperature. Those patients, who had a fever of 100° or more at the onset of treatment, continued to have this rise of temperature almost without exception. We did note in several patients a transient rise in temperature following the injections.

4. One patient suffered a pulmonary hemorrhage while under treatment.

5. On the basis of physical signs the following was noted: that sixteen showed improvement as evidenced by diminution in moisture, areas of impaired resonance became less in extent and the breath sounds less harsh in character. There was no change noted in four patients, while in five the disease was progressive.

6. No special or serious reactions were noted in the entire time that the work was being done.

7. No attempt was made to run a parallel series of cases not under this special drug. Yet in going over the records of former patients in the institution, the impression was gained that untreated cases had done as well as those who had had the injections of sodium morrhuate.

As a result of this work, I agree with Rogers that sodium morrhuate is not a specific for tuberculosis. But I cannot agree with him that in the use of the drug we have the best line of treatment for tuberculosis in general. Further work with sodium morrhuate should be undertaken to prove or disprove the views of Rogers.

REFERENCES

(1) Biesenthal, M.: The use of sodium gynocardate 'A' in pulmonary tuberculosis. Amer. Rev. Tuberc., 1920, iv, 84.
(2) Rogers, L.: Sodium morrhuate in tuberculosis. Brit. M. J., February 8, 1919, 147.
(3) Ganguili, G.: Sodium morrhuate in tuberculosis. Indian Med. Gaz., April, 1920, 131.

TUBERCULOUS MENINGITIS AS A COMPLICATION OF PULMONARY TUBERCULOSIS

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It is conceded that perhaps three-fourths of all cases of tuberculous meningitis occur in young children. But inasmuch as this terminal condition is fairly frequent in adults afflicted with pulmonary tuberculosis and presents a somewhat different clinical picture, it might be well to isolate this group for special study. It is not the object of this paper to repeat the well-known symptoms and physical signs of meningitis but to point out certain clinical constancies not ordinarily emphasized in textbooks and to outline a plan of management based on the peculiar course of the disease in the sanatorium patient.

ETIOLOGY

Occurrence. From January 1, 1916, to May 1, 1920, there were 16 cases of tuberculous meningitis in this institution. During the period mentioned there was a total of 287 deaths. In other words, about one out of every eighteen deaths, or 5.6 per cent, was due to tuberculous meningitis.

Age. As one would expect, the disease occurs at a period when deaths from pulmonary tuberculosis are most frequent. Thirteen of our cases were between the ages of twenty-four and thirty-five.

Sex. About one-fourth of the inmates in this institution are women, yet all our meningitis cases were male. The preponderance of males over females seems to be well established by numerous observers.

Extent of pulmonary lesion. All but one had extensive pulmonary involvement.

Other complications. Genitourinary tuberculosis was astonishingly frequent. Ten of our cases probably had genitourinary tuberculosis; eight surely, judging by the pyuria, the recovery of acid-fast bacilli in smears, guinea pig inoculation or palpable evidence of epididymal infection. Infection of the epididymis occurred seven times. In the

Guy's Hospital Report (1) of six cases of tuberculous meningitis in adults, three were found on postmortem examination to show renal tuberculosis.

Injury to the central nervous system. In one of our cases, the meningitis occurred six weeks after the administration of stovaine intraspinally as an anesthetic for the removal of a tuberculous kidney. In another, there was a definite sequence of spinal caries, cord irritation and meningitis. This patient also had a tuberculous epididymis. In a third, a very acute spinal tuberculosis was followed by meningitis. It is difficult to correlate cord injury with a lesion at the base of the brain on the ground of *locus minoris resistentiae.*

PATHOLOGY

Inasmuch as postmortem examinations were made on only three of our cases, we do not feel that we are in a position to make special observations. Examination revealed in all three cases a clear superior surface with scant turbid exudate at the base, fine tubercles in the pia immediately overlying the region of the Sylvian fissures and some distention of the lateral ventricles. In one case which clinically had had a hemiplegia, with hemiparesis of the face and tongue and an aphasia, we were unable to find any other gross brain lesion on careful examination.

SYMPTOMATOLOGY AND COURSE

Headache is by far the earliest and most constant of the symptoms. It was present in all the cases but one (in this it was entirely absent) as the initial symptom. It is present each day and persists all day. It resists all treatment. It may be frontal or occipital or feel "as though the top were coming off." There is nearly always fever or a sharp increase of existing fever. When the patient has been having a normal temperature the rise may be step-like, quite similar to that during the first week of typhoid. In fact the two diseases may be readily confused. Two of our cases were totally afebrile throughout. Accompanying the headache and fever, there are usually mild mental symptoms, such as slowness of speech, a misplaced word or an inappropriate reply to a question. This triad—obstinate headache, fever and change in mentality—in the course of pulmonary tuberculosis, is wellnigh pathognomonic. Uremia, which it resembles, is far and away the rarer of the two conditions in the ordinary run of sanatorium practice.

Dissociation of pulse and temperature is quite constant, the pulse curve crossing and recrossing the temperature curve many times in graphic charts. After perhaps ten days or two weeks the headache ceases to be a prominent symptom, but the mental symptoms become more pronounced. There is marked drowsiness and often low muttering delirium with subsultus. The patient can usually be aroused sufficiently to answer questions; but the answers are made in an uncertain, hesitating manner appropriate at first, but soon becoming irrelevant. Lateral decubitus is the most common position at this stage. Photophobia is the rule. Stocker's sign is constant,—the patient resists when the coverings are pulled down or the clothes loosened for examination. There may be a very excited type of delirium: the patient may get out of bed or attempt violence. One of our patients began caning a fellow patient before he was got back to bed and into a restraining sheet.

Soon the patient becomes more and more stuporous, drifting into coma, with involuntary bowel movements and urinary retention, which, unless guarded against, becomes urinary overflow. The sputum, which is as a rule plentiful, is at first expectorated in all directions, but later allowed to accumulate in the bronchi, larynx and pharynx, purulent material dripping from the mouth or collecting in tenacious strings about the teeth and lips. Emaciation occurs rapidly, the countenance assuming a characteristic ashy-cyanotic tinge. The patient now lies on his back. Paralysis of both extrinsic and intrinsic eye muscles is common. Ptosis of one eyelid, external strabismus and a dilated, fixed pupil are the most usual palsies. More rarely there is hemiplegia. We have had one case. Legry (2) reports one case. Sauer (3) reports two.

Before death the chest fills up with large bubbling râles, audible at some distance. It almost seems at times as though the patient were slowly drowning in his own secretions. Duration of the illness has in our cases varied from eight days to four and a half weeks.

The symptomatology in adults differs from that of children in the early subjective character of the symptoms, the absence of convulsions (none having occurred in our cases), the infrequency of cerebral vomiting and in the prominence of the pulmonary symptoms, especially toward the close.

The physical signs have in our cases been quite in accord with textbook descriptions. Rigidity of the neck, general hyperesthesia and Kernig's sign have been early and constant. The knee jerks are at first increased, later depressed. At times a short ankle clonus can be obtained.

A positive Babinski, Oppenheim or Gordon reflex on one or both sides has been fairly constant.

Beggs (4) emphasizes a dilation of one pupil which reacts promptly to light as an early sign, perhaps the earliest of the physical signs. (This dilation must not be confounded with the fixed dilated pupil characteristic of the paralytic stage.) After several days to one week it becomes the typical contracted pupil of the irritative stage. The eye grounds as a rule reveal nothing of importance. Choroidal tubercles were consistently absent in spite of careful routine examination. Examination of the blood reveals usually a moderate leucocytosis with a normal differential count. However, since most of our sanatorium patients with fever show a similar leucocytosis, one can attach little importance to a routine blood-count.

Lumbar puncture. The characteristic fluid is clear, with fine grayish-white flocculi. It spurts out of the needle in a stream when the trocar is withdrawn. The most constant laboratory findings are a positive globulin test, a progressive increase in the cell count and, fairly frequently, tubercle bacilli in the smears. Mononuclear cells predominate, constituting 70 to 100 per cent. In examining spinal fluids for tubercle bacilli we have made smears of the film which forms after twenty-four hours in the ice-box. In making guinea pig injections, adherence to the following technique will secure a high percentage of positives. The twenty-four hour film is floated onto a sterile new glass slide. It is partially allowed to dry, then macerated with a sterile needle and spread as though for a smear. The original spinal fluid or sterile saline solution is now added and thoroughly mixed with the smear to form an emulsion, enough of the solution being added to make a convenient quantity for injection. The reason for drying and breaking up the film is that it is nearly impossible to inject the unbroken film through an ordinary syringe. It remains adherent to the glass barrel of the syringe after the fluid is injected. Eleven spinal fluids were inoculated into the peritoneal cavity of guinea pigs and all resulted in generalized tuberculosis. In six smears made directly from the spinal fluid, we found acid-fast bacilli. The number of positives seems to depend upon the length, carefulness and repetition of the search. Where it is essential to establish the diagnosis early, on an incontrovertible basis, such search is justifiable. But tuberculous meningitis in the course of pulmonary tuberculosis ordinarily presents such a clear-cut clinical picture, that it is usually unnecessary to wait for laboratory confirmation.

PROGNOSIS

All of our cases ended fatally in from one to four weeks. True cases of tuberculous meningitis have ended in recovery. Pitfield (5) reports a case, cites 29 undoubted instances in medical literature and quotes McCarthy (*Phipps Institute Reports*) as having, from time to time, found evidence of healed tuberculosis of the central nervous system in postmortem examinations. Reichman (6) reports two recovered cases.

TREATMENT

Prophylactic. The frequency of the genitourinary tuberculosis in association with meningitis would make one wonder if there were not some etiological relationship and whether prompt surgical treatment of the genitourinary condition might help to prevent meningeal complications. However, three of our epididymis cases (one with renal tuberculosis who had had a nephrectomy) had been operated on. The intervals between operation and meningitis were six weeks, two years and three years.

Direct treatment. Daily lumbar punctures during the period when headache is prominent will often mitigate this symptom. We have found it of little service in altering the later course of the disease. The injection of the ordinary antiseptics intraspinally (we have used and abandoned iodine in the form of Lugol's solution) scarcely seems rational as it is impossible to use them in sufficient concentration. Local applications of antiseptics to tuberculous processes, even in great concentration and to easily accessible areas, such as the larynx, has proved disappointing. We can hardly expect better results from similar treatment in meningitis.

Although at this time specific therapy is out of the question, we can nevertheless do a great deal for the patient. He should be in a darkened, quiet room. He should be fed by an attendant as long as there is a swallowing reflex; and later by intermittent Murphy drips, using peptonized milk. It is important to keep up a constant supply of fluids in order to prevent the horrible drying and cracking of the tongue and lips which will otherwise appear. When there is urinary retention he should be catheterized at least twice in twenty-four hours. This will prevent overflow and soiling of the bed. The bowels should be moved by daily enemas and soiling prevented by proper diapering. The most troublesome feature of the treatment is taking adequate care of the

sputum. We have found it most feasible to use old sheets or gauze as a bib and draped about the head of the bed in order to catch the expectorated sputum. These sheets are, of course, later burned. Cleanliness of mouth and body and prevention of bed sores are important measures. In short, in the absence of specific therapy, these patients are at least deserving of decent, humane nursing and whatever comfort the attending physician can procure for them.

The following brief case reports are appended as of special interest:

Case no. 1. Meningitis with hemiparalysis and aphasia. J. B., hosp. no. 3456, male, age thirty, admitted October 21, 1919; died December 8, 1919. Far advanced infiltration to consolidation, involving the greater part of both lungs with cavitation in upper lobes. Since admission patient complained daily of excruciating headaches which resisted coal tar analgesics and even narcotics. Daily fever to 103° or over, with marked mental depression. When seen by Dr. Beggs on December 3, 1919, there was a characteristic inequality of the pupils, the right being dilated but reacting to light. A lumbar puncture was done, 20 cc. being removed under moderate pressure. Laboratory examination showed positive globulin, negative Fehling's and 3 cells per field. Smear negative for tubercle bacilli. On the following morning (December 4) it was apparent that the patient had developed a sudden right-sided hemiparalysis (arm, leg and face). He did not appear to understand questions or to be able to answer them. However, he protruded the tongue when set an example. *Physical Examination:* (Dr. Moleen): Spastic paralysis right arm and leg. Right side of face weak in all areas, but especially in lower portion. Closes both eyes. Divergent strabismus with failure of conjugate movements. No nystagmus. Right pupil larger than left. Does not respond to light. Bladder distended. Abdominal reflexes present. Anesthesia in trifacial and cervical areas. High-pitched short percussion note over right parietal eminence. Cracked pot sound over left. Bilateral increased knee-jerks. Bilateral ankle clonus, more marked on right side. No wrist clonus. Babinsky negative on both sides. Oppenheim negative on right, positive on left side. Similar reaction with Gordon. Eye grounds: discs are sharply outlined, somewhat paler than normal. Fundus vessels tortuous. No visible tubercles in choroid. The spinal and blood Wassermanns were negative. Colloidal gold gave the following reaction: 5411111122. Patient was in coma for 24 hours before death. *Post mortem examination:* Numerous tubercles in pia-arachnoid over both Sylvian fissures but chiefly in left. Choroid plexus in left lateral ventricle showed pin-point nodules. The lateral ventricles were both moderately distended. No other lesion found on section.

Case no. 2. Meningitis occurring six weeks after operation. L. S., hosp. no. 3282, male, age thirty-two, admitted April 10, 1919. Died September 21, 1919. Pulmonary tuberculosis for five years. *Pulmonary lesion:* Far advanced fibro-ulcerative infiltration to consolidation greater part of both lungs. Renal tuberculosis discovered a few weeks before admission. The patient also had tuberculous infection of both epididymes. On July 16, 1919, he was operated upon under spinal anesthesia (stovaine), the left kidney being removed. The postoperative course was uneventful and patient was ambulant till August 25, 1919, at which time he complained of a severe frontal headache and a slight rise of temperature (99.6). There was a great deal of mental depression. The headaches persisted. The fever increased daily and was remittent in type. There was marked dissociation of pulse and temperature. Blood cultures were negative for typhoid or other organisms. Widal negative on the seventh and twelfth days. Towards the end of the second week patient complained that things looked double and that the light hurt his eyes. Lumbar puncture was first done on September 12: 50 cc. clear fluid with flocculi was obtained: positive globulin, negative Fehling's, 43 cells to the field, mostly leucocytes. Tubercle bacilli found in the fourth smear after one hour's search. Guinea pig injection of the spinal fluid resulted in generalized tuberculosis. Patient was in coma for three days before death.

Case no. 3. Meningitis following spinal tuberculosis; no fever. B. B., hosp. no. 3102, male, age forty-one. Admitted June 16, 1918. Died February 1, 1920. Pulmonary tuberculosis for six years before admission. *Pulmonary lesion:* Far advanced fibroid tuberculosis greater part of both lungs with emphysema and chronic bronchitis. *Complications:* Tuberculous arthritis, right knee, for three years. Tuberculous epididymes on admission, unknown duration. Spinal tuberculosis, with development of kyphus in August, 1918: treated by brace. In May, 1919, patient developed symptoms suggestive of cord irritation: weakness of lower extremities, spastic gait, exaggerated knee jerks. Chest placed in a plaster cast. During the first two weeks of January, 1920, it was noted that there was a marked increase in spasticity of lower limbs with more weakness. On January 19, 1920, began to complain of severe headaches which persisted. Irrational on January 26, with marked photophobia, rigidity of the neck and right facial paralysis. Tongue deviated to the right. Patient in coma for three days before death. Lumbar puncture was first done on Jan. 26: 40 cc. obtained under pressure. *Laboratory findings:* globulin positive, Fehling's negative, 28 cells per field mostly lymphocytes; smears negative for tubercle bacilli but an injected guinea pig developed generalized tuberculosis. At no time did this patient's fever rise above 99°.

Case no. 4. Meningitis following spinal tuberculosis. M. W., hosp. no. 3084, male, age twenty-six, admitted May 30, 1918. Died September 14,

1918. Pulmonary tuberculosis two years before admission. *Pulmonary lesion:* infiltration to cavity formation greater part of both lungs. Patient was ambulant, afebrile and felt well till August 20, 1918. At this time he began to complain of severe pains in lumbar region. Fever increased daily till it reached 102° on August 28. Physical examination at this time revealed a definite kyphus in the region between the 11th dorsal and 2nd lumbar vertebrae which surely had not been present on admission and was not noticed previously in spite of monthly chest examinations. During the week following August 28, the patient ran a daily remittent fever of 101° to 103° and showed marked dissociation of pulse and temperature and was irrational with a tendency to increasing stupor. On September 9 physical examination showed unequal pupils (left larger) reacting sluggishly to light and marked rigidity of the neck with positive Brudzinski. Knee-jerks hyperactive on both sides with a positive Oppenheim on the right. Lumbar puncture drew 60 cc. of clear fluid with flocculi under pressure. The globulin was positive. Fehling's negative; 140 cells to the field, all lymphocytes; tubercle bacilli found in smears and guinea pig injections resulted in generalized tuberculosis. Before death, patient developed a right facial paralysis. No complaint of headaches, if present, was made.

REFERENCES

(1) Tuberculous meningitis in adults, Medical References Gazette, 1863, ii, 274.

(2) Legry, T.: Bull. Acad. de Méd., Paris, May, 1918, lxxix, 393.

(3) Sauer, L. W.: Arch. Pediatr., December, 1915.

(4) Beggs, Wm. N.: Personal communication and in statement at a meeting of the Denver County Medical Society.

(5) Pitfield: Amer. Jour. Med. Sci., 1913, cxlvi, 37.

(6) Reichman, V.: Münch. med. Wchnschr., June, 1913, 1375.

PREGNANCY AND TUBERCULOSIS[1]

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There has been an almost universal belief that pregnancy as a complication of pulmonary tuberculosis exerts a serious influence upon the course of the disease, regardless of its extent or activity, and that even when the patient shows evidence of improvement during the pregnancy, she usually fails rapidly during the puerperium or lactation.

From the time of Louis (1) published statistics have shown that women pay a heavier toll to tuberculosis than do men, but recent studies compel us to realize that at the present day as far as England and Prussia are concerned the reverse is true. Cobbett (2) states that in England and Wales a study of the figures, for the first decade of this century, shows that four males die from tuberculosis for every three females. During childhood and adolescence girls suffer more than boys. From the age of twenty onwards young men begin to die from tuberculosis more frequently than young women; and the maximum disparity is reached between forty-five and sixty-five, when the mortality among men is twice that among women. For the age period twenty to twenty-four, 122 males die for every 100 females; from twenty-five to thirty-four, 131; and at age thirty-five to forty-four, the proportion reaches 153 to 100.

A study of vital statistics does not suggest to us that pregnancy and childbearing exert an extremely unfavorable influence. Except in the patient with far advanced phthisis, we not infrequently find that our patients appear definitely improved during the period of pregnancy. There may be no marked change for the better in the pulmonary findings, yet the general nutrition suggests a beneficial influence. In the researches of P. Bar, quoted by Robin (3), we learn that in pregnancy the healthy mother fixes more nitrogen, utilizes in a better manner the sulphur of her albuminoids and the iron of her food and at the same time mobilizes a larger quantity of phosphorus and lime. Meanwhile more

[1] Read at the Fortieth Annual Meeting of the Ontario Medical Association, Toronto, May 27, 1920.

oxygen is consumed and more carbon dioxide produced. All this represents a form of hypernutrition, the products of which, intended for the foetus, can be very useful to the mother, who thus derives a certain profit from her greater histogenetic activity. For the patient to benefit by this hypernutrition she must eat, digest, and assimilate well, otherwise her own tissues will suffer. During the last two months of pregnancy she has to provide for the osseous system of the foetus, and to do this there is a demand for decalcification of her own osseous system, the reserves of which have already perhaps been depleted on account of her tuberculosis, and this leads to a condition of demineralization unless digestion and assimilation are active.

The nausea and vomiting so frequent early in pregnancy are strikingly absent in the majority of the tuberculous. With enhanced appetite and good digestion the general condition improves and with this there is not infrequently a decided change for the better in the pulmonary process. This change for the better I have noted in cases in which it was considered that the condition of the lung was such as to warrant an interruption of pregnancy. So frequently have I seen a patient do well after interruption had been decided upon but for various reasons not undertaken, that I am convinced that this procedure is never justifiable without a most careful survey of the case from all points of view and especially that of further observation.

In the light of experience, knowing how well some patients do when left alone and how badly others do who are treated by emptying the uterus, it would seem most difficult to make a just prognosis in any large proportion of cases. I have seen cases in which tuberculosis became active during pregnancy and which grew steadily worse. I have seen as many do badly when abortion was performed, and death has resulted, both when interference was undertaken and when not.

The effect of pregnancy upon the tuberculous patient is influenced by numerous conditions, (1) the stage and activity of her disease, (2) her general nutrition, (3) the care and attention given during and after pregnancy,--upon these rather than whether pregnancy is interrupted or allowed to proceed.

The patient with quiescent disease and good nutrition and digestion will probably give birth to a strong healthy child. If relieved of the care of the child and of lactation she will probably pass through this latter dangerous period without recrudescence of her symptoms if kept at rest for a period of six to eight weeks.

If the disease be active it may become more acute either during pregnancy or more probably during the puerperium; and the more advanced and active the disease, the greater the danger.

It is possible that in the early months of pregnancy in a woman with slightly active disease, vaginal hysterotomy under gas and oxygen anesthesia may be undertaken without ill effect; but, generally speaking, the value of inducing abortion, as usually undertaken, may be considered at least questionable and the operation in my opinion is rarely justifiable.

We must, however, recognize that pregnancy is always to be looked upon as a serious complication in the tuberculous and is to be avoided. When it does occur the patient must be placed under strict treatment, with the obstetrician and internist working in coöperation.

Labor should be made as easy as possible. No patient is to be allowed to go beyond term; and in many cases it would seem desirable to induce premature labor two or three weeks before term. The second stage of labor is to be made as short and as free from pain and exhaustion as possible. After parturition the child is to be taken away from the mother in order to avoid infection, and to save the mother the strain of lactation.

With the tuberculous mother the usual nine days of bed rest must be extended. Less than four weeks' bed rest is rarely justifiable and with active disease a much longer period is to be insisted upon. In the absence of active symptoms, temperature observations and frequent chest examinations are to be undertaken to recognize the appearance of any sign of reactivation. In short, a strict regimen of bed rest is to be observed, not only during the pregnancy but for a variable and prolonged period after delivery.

The child is usually born healthy and free from disease. The danger of infection is postnatal and the mother must not be allowed to care for the child.

The dictum of the French clinicians sums up several points of importance to the tuberculous. If a girl, no marriage; if a wife, no pregnancy; if a mother, no suckling.

Time will not permit a discussion of the question of the marriage of the tuberculous, and though relevant is not within the scope of this paper.

In recognizing the gravity of pregnancy as a complication of tuberculosis, it is our duty to warn our patients of the dangers which accompany it, and it is but humane and just that they be instructed how to prevent conception.

> Though pregnancy has generally a disastrous effect upon phthisis, phthisis, unless far advanced, has little effect upon conception and pregnancy. Procreative power is said to be somewhat above the average in phthisical women, but sexual appetitie is not much impaired except in the last stages of the disease. When pregnancy occurs the child is usually carried to the full term and born in the natural way. Abortion rarely occurs unless the phthisis be far advanced or associated with high temperature and violent coughing. When artificially induced it produces more harm than if the pregnancy had been permitted to run its full course.

This is West's wise summary.

Recent reports have been made upon a series of cases: by Norris and Landis (5), 68 cases; by Walsh (6), 38 cases; and by Stewart (7), which have given us much further light upon this subject and allowed us to formulate a series of conclusions.

Walsh agrees rather thoroughly with Robin (3) that we should forbid marriage to tuberculous subjects, though he thinks the quiescent case may marry after treatment and education. In his opinion pregnancy is to be forbidden to the phthisical but if it should occur it should not be interrupted, for, putting aside criminal abortion which might be encouraged by such advice, the mother will lose by this procedure more than she can gain, as the mortality in a series of cases is just as great as in natural parturition and its consequences.

Walsh also quotes the French school with Pinard at its head, whose experience makes them forbid the interruption of pregnancy in all stages, for even when the tuberculosis is advanced and acute they contend that at best it is only the destruction of a healthy life in order to lengthen a sickly one.

The views expressed by Flick (8) should carry much weight:

> I believe that if every pregnant woman coming under observation, whether she be in the early or advanced stage of tuberculosis, is carefully treated during her pregnancy and aseptically delivered, her chances of life, aside from those of the life of the child, would be much better than by the termination of pregnancy. This opinion is based upon a rather large experience. Of course we all agree that if pregnant tuberculous women are allowed to go without proper care evil results will follow. I think, however, that as conservative physicians it is our duty to try to save life, not only the life of the mother but of the child. Furthermore, that if it is possible by proper scientific treatment during the pregnancy to make the woman's chances of life even as good without abortion as by terminating pregnancy, it is our duty to follow this course.

SUMMARY AND CONCLUSIONS

1. Tuberculosis of the lungs exerts practically no influence against conception.

2. It seems to exert little influence on the course of pregnancy and unless the patient is in a far advanced stage of the disease has little or no tendency to cause abortion, miscarriage or premature labor.

3. Pregnancy may prove a dangerous complication in tuberculosis of the lung, especially if the disease be active.

4. A woman with active tuberculosis of the lung should not marry.

5. A tuberculous woman should not become pregnant unless her lesion is limited and active signs have been absent for at least two years.

6. There are no rules we can follow which will aid us to determine with certainty which cases will bear the added strain of pregnancy well and which badly. It is equally difficult to determine in what cases an abortion will improve the future prospect of the pregnant woman. As in all forms of treatment of tuberculosis we must individualize, all rules fail.

7. Intervention after the fifth month rarely gives satisfactory results. Prior to the fourth month, it is possible that the mother's future may be improved by emptying the uterus through the modern operation of vaginal hysterotomy under gas and ether anesthesia, that is, by avoiding shock incident to a prolonged operation or ordinary anesthesia or loss of blood.

8. Labor should be made as easy as possible. The induction of premature labor two weeks before term may be advisable.

9. The tuberculous mother must not nurse her child.

10. The ordinary hygienic and dietetic treatment of tuberculosis must be strictly observed during pregnancy and the puerperium, for at least six weeks after all evidence of pulmonary activity has subsided. The obstetrician and the internist should work in closest coöperation.

11. A pregnant woman, giving a history at all suggestive of pulmonary tuberculosis, should be subjected to a thorough examination by a competent internist at the earliest possible date. Only in this way can the proper treatment be instituted at the time when it is most valuable.

REFERENCES

(1) Louis, P.: Note on the relative frequency of phthisis in the two sexes. Annal. d'hygiene publique, 1831, vi, 50.
(2) Cobbett, L.: The causes of tuberculosis. Cambridge, 1917, p. 6.
(3) Robin, A.: The treatment of tuberculosis. New York, 1913, p. 403.
(4) West, S.: Diseases of the organs of respiration. London, 1902, p. 519.
(5) Norris, C. R., and Landis, H. R. M.: Pregnancy and tuberculosis. Amer. Jour. Obstet., June, 1916.
(6) Walsh, J.: Pregnancy in cases of tuberculosis of the lungs. Ibid., February, 1918.
(7) Stewart, D. A.: Tuberculosis and maternity, a study of 200 maternal histories. Trans. Canad. Tuberc. Assoc., Ottawa, 1917, p. 41.
(8) Flick, L. F.: Amer. Jour. Obstet., February, 1918, 331.

CLIMATE[1]

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One almost feels as though an apology should be offered for presenting a paper on climate before the National Association. On the other hand, it is my firm conviction that an honest paper on this subject has yet to be written. This paper, I trust, bears at least the ear marks of truth, and is, I assure you, written with a desire to solve as far as it is humanly possible this perplexing question.

There is no more apt illustration of the spirit of reform than the reformation in the treatment of tuberculosis which swept this country a number of years ago, when a few good institutions showed the medical profession what good results could be obtained in one's home climate. Up to that time people had been advised to go West and rough it: a glance at a mountain peak, a breath of ozone and the trick was turned —a cure for tuberculosis.

With such advice, results were more or less disappointing, while with proper care in well conducted institutions in Eastern climates, results were more or less gratifying. The pendulum swung,—it couldn't help it. It more than swung,—it turned completely over; and it required years before the more honest members of the profession were willing to grant *any* value to climate.

What happened? The Western man looked into the future and saw the vast reaches of the Southwest without a consumptive. His hopes were blasted. His livelihood was gone. To save the day, he rallied his forces and at once began to herald the value of climate. His particular spot in all the Southwest was the one particular niche that Nature had set aside for the unfortunate consumptive. The remaining towns were either too hot or too dry, too high or too low. He had made a thorough personal inspection of each and every canyon and after an exhaustive research had hit upon his particular locality as the only fit spot in which to get well. This, of course, brought forth a storm of

[1] Read before the Clinical Section of the Sixteenth Annual Meeting of the National Tuberculosis Association, St. Louis, Missouri, April 23, 1920.

protest from the other Western resorts, and, as a consequence, the West found itself in mortal combat. The question at once presented itself, how, when we were not at all agreed as to the value of climate, could we ever hope to convince our Eastern colleagues? And I am forced to confess we never have. We still wrangle and get nowhere.

It is interesting to note that little scientific work to prove or disprove this value of climate, has ever been published. We know that elevation increases the red blood cells, and that, with increasing elevation, there is a physiologic increase in the expansion of the chest from one to four inches. We also feel sure that white cells, especially the lymphocytes, are increased markedly by altitude, and that the average blood pressure of consumptives is equal to the average for normal people at sea level. We think blood platelets are increased by the same means, and yet we must admit that all these changes are due to the elevation and not to dry air and sunshine. On the other hand, the results in the treatment of tuberculosis are equally as good in the low elevation of the Southwest as in the higher altitudes. These facts make us pause. Possibly the arguments of those who are not biased and who enter this controversy with an open mind, that the changes are all physiological and necessary for the proper maintenance of metabolism, are right. For my part, I do not know. My honest opinion is that nobody knows.

Another point of great interest is the change of heart seen in the men who have worked East and West. Like myself, when they first come, they are carried away with the absolute change of environment. They are imbued with the perpetual sunshine,—the ease with which one chases a cure, the cheer that climate gives one, and, true doctors always, they rush into print telling of the marvels of climate and the great advantages the West has over the East in the treatment of tuberculosis. The result is a one-sided paper praising the West and damning the East, and keeping honest men as far apart as ever.

There are two reasons for this: one is commercial; the other, an opinion formed by first impressions. The man who writes commercially is hopeless: the other may in time develop into an asset rather than a liability.

Truth, apparently, is not one of the most conspicuous virtues of the average man East or West. Disadvantages of particular localities are expounded as advantages. I often wondered just what value lay in the dust storms which sweep the plateau region every spring; and it was not until the vast knowledge gained during the war that an explana-

tion offered itself. The fact that the inhalation of cigarette smoke due to its irritant effect on the mucous membranes tended to stimulate a reaction that raised the resistance of the cells locally, thereby protecting the smoker rather than making him more susceptible to disease, proved beyond the question of a doubt that the dust storms in the Southwest act in the same marvelous manner. I can go a step farther and show that owing to the large lime deposits in the soil, the dust tends to carry these salts in large quantity into the consumptive's system, thereby overcoming the lime starvation which supposedly takes place in tuberculosis. Another important point for climate. This, gentlemen, is humbug, but I leave it to you if it is not as convincing as most of the scientific arguments so far brought forth.

Personally, I have never noted harm from such storms, but I grant they are very disagreeable when they occur. But why place them in a category by themselves as one strong reason why an individual should not seek a change of climate. Are there not as serious drawbacks in the Eastern section of the country?

I believe there should be a broader bond established between East and West. Education tends to overcome great obstacles, and I am convinced that if once the Eastern physician could visit this section and acquaint himself with facts gleaned from personal observation, there would be less misunderstanding. We were all, broadly speaking, Eastern men originally. We all obtained our education in Eastern and middle Western schools, and our own ideas of medicine are yours. Sometimes I am conceited enough to think that many of our men are even broader-minded than your great average.

The same fundamentals in medicine are taught among us as you teach, and most of the men in tuberculosis work are human beings like yourselves. The West is young; but add to her energy years of experience, and there must be no great difference of opinion. We know the conditions under which you treat tuberculosis. But do you know ours? We have as well-equipped institutions throughout the Southwest as you have East. Not in numbers we grant, but the averages are as good. Before talking climate, learn that the elevations in New Mexico and Colorado are, to all intents and purposes, the same; and that when you seek lower points, Arizona has them to offer. This may seem elementary but the ignorance of the Eastern physician, on just such points as these, is appalling. He does not know the A, B, C's of Southwestern conditions, and yet he will attempt to advise his patient intelligently.

Then there are a large number of Eastern physicians who feel that the West is filled with an incompetent profession, and who send their patients to the well country advising them strongly against seeking the advice of a physician in that country. It is not at all uncommon to have a patient drift into the office for consultation, who says that he has been West for months but has never consulted a doctor, for his family physician had said, "Go West and rough it, but whatever you do, stay away from the doctors." Usually this type of case has thrown away what chances he or she may have had in the beginning of their trouble. Advice such as this can only be considered criminal, and yet hundreds of health-seekers are receiving it yearly. If the Eastern physician who gives such advice cannot acquaint himself with conditions in the Southwest, he should cease to send patients there. It is unfortunate that such ignorance must be tolerated by the better elements in the profession, for the unfortunate consumptive is the victim, the one who suffers by reason of such ignorance.

As I have previously stated, education is the solution of this problem, but this education must be from personal experience and observation. It has been my experience that Eastern men, who have visited the Southwest, go back with a much better impression of the profession and the means of caring for the tuberculous, than they had before such visit was made.

The old West is a thing of the past. Throughout even the remote corners of this vast region, the modern idea has caught root. Aside from the general topography of the country, one sees towns and cities in no particular different from the East, and the people themselves are far less provincial.

I have told you thus far much that may make you feel that I am not a believer in climate. In fact, I may even gain the enmity of that part of the profession of the Southwest who may be classed with those whose commercial instincts have overgrown their scientific instincts. But I am a believer in climate. No man could live in the Southwest fourteen years and not be. The sunshine is contagious; the few cloudy days perhaps somewhat a relief. The very atmosphere of the country spells health. Well people feel better in the stimulating air of the mountains, and a large number of Eastern failures are given a lease on life yearly. I am convinced that in well-conducted institutions there the results are 10 to 15 per cent better than in Eastern sanatoriums. On this, then, I base my belief in climate. But when all is said and done,

the question of climate can be summed up in the one word, *luxury*. I say this advisedly, for the Southwest is not the place for a poor patient. No one with tuberculosis in an active state should be sent to the best climate on earth without sufficient means to last him a year in idleness. If the Fates are kind, he may be in a position to work before that time, but much more often he is not.

Let me emphasize for the benefit of the doctor who forever misunderstands that I lay stress on sufficient finances for the patient's sake, and not my own. It is far more important that the patient be placed in the home state sanatorium where proper care and attention can be given him, than to send him to the best climate the world affords where he must live under poor conditions and work to gain even the bare necessities of life. Work and tuberculosis do not go hand in hand, yet many times every month I see patients who have been sent to the Southwest, and on arrival have barely enough to pay board and room one week. If they have the price of a ticket home, I advise that they use the money to return and enter a local institution, for any honest man knows that care and good food plus proper supervision are far more essential than climate. Lest I again be misunderstood, I state most emphatically that the same honest men know that care, and good food, plus proper supervision plus climate make for all that is best in the treatment of tuberculosis. Move a pauper from the slums of a great city to a county or state sanatorium, and you have changed his climate and given him an opportunity to get well. Change a man of means from the East to the plateau region of the West, and you have given him the same opportunity. The question of change is the keynote to success.

One hears a great deal from the anticlimate man about the long journey, the terrible homesickness incident to change, the inability of relatives to be nearby, etc., etc.

Homesickness is a figment of the imagination. It is seldom that I encounter a patient who gives me worry from this condition, and when I do, it is a problem of the hopeless patient rather than the one who offers chances of a result. One out of ten may suffer from this condition, but the chances are equally good that this individual would be homesick anywhere. The ability of relatives to visit at intervals would give no relief to people so constituted.

Another bugaboo that clings to the mind of the average Eastern doctor is the question of elevation and hemorrhage. From a careful study of statistics, I can find no reason for such belief. If statistics

ever proved anything it is the fact that hemorrhages are less frequent at higher altitudes than at sealevel. Throwing this pertinent fact into the scrap heap, it is a matter only of clinical observation to know that they occur with no more frequency at six thousand feet, than at lower altitudes or the seashore. I have seen patients placed on a train in the East and the bleeding continue until they reached the higher altitudes, when it stopped. I have seen them sent from Albuquerque, bleeding profusely, and reach a low elevation and die of a severe hemorrhage. To cite the reverse, I have seen them sent up without hemorrhages, and die on arrival with hemorrhage. I have seen them have hemorrhages going and coming—in elevations and out of elevations; and the one glaring significant fact that presents itself for consideration is that we don't know anything about hemorrhages, why they have them, or why they don't. But we do know, and any honest man will bear me out, that therapeutic elevations have no influence, one way or another, on the occurrence of bleeding, and that a hemorrhage case is as safe in one part of the country, as it is in another.

Another misgiving, that has torn the mind of patient and physician, is that of returning to the home climate once a result has been effected in the West. Arrested tuberculosis is arrested tuberculosis. Once this has been accomplished, there is nothing against the patient's return home. In other words, he can live East exactly as well and with exactly as much safety as though the result had been attained there. I, personally, feel that one's best chances of permanent result lie in living West, whether the cure were obtained here or in an Eastern climate. On the other hand, I have many patients who have returned home and have enjoyed good health for years under adverse climatic conditions.

Again, let me question the belief in unbearable summers. During my fourteen years in New Mexico, I have never suffered from heat, and that is much more than I can say for my home climate in the Great Lakes region. June is the hottest month, the so called rainy season starting in July and continuing through August, with a shower two or three times weekly. The remaining summer is delightful. The nights are always cool, and one requires a blanket even after the hottest summer day. For this reason, it is needless to keep patients from climatic change until the fall months. One season is as comfortable as another.

I often wish that I could be at the other end of the line to advise patients relative to climatic change. Once the diagnosis of tuberculosis is decided upon, an honest attempt can be made to try out the home

climate. Usually a question of four or five months under careful supervision will at least do the patient no harm. Note that careful supervision, success or failure depend wholly upon that one factor. At the end of that period, if the patient shows no evidence of getting better, or the general condition is worse, do not keep them indefinitely in a vain endeavor to have a miracle happen, but advise climatic change at once. We receive then a patient who has had good training and who offers a reasonable chance of recovery, instead of a far-advanced, hopeless consumptive who probably dies within six months of arrival. He curses the climate for not furnishing him with new lungs, and his friends and relatives for generations to come tell the world that the Southwest is the last place on earth to take a consumptive.

Not so long ago, the Public Health Service made a survey of conditions in the Southwest, and this investigation showed that nearly 50 per cent of the tuberculous died within six months of arrival. This, gentlemen, is not an argument against climate, but rather a sad commentary on the advice to dying consumptives by men East, who are supposed to exercise average intelligence in dealing with patients.

There are certain types that do not do well at high elevations, and when a change is advised, these patients should be sent to low points, such as Tucson or Phoenix, Arizona. Patients with a marked amount of fibrosis or with well-developed kidney lesions, or with heart lesions that are not compensated should not be sent to the altitudes of the Southwest; but they can be given the opportunity to enjoy the advantages of a dry climate in the resorts mentioned.

Again let me state that I am a believer in climate. I repeat this for the benefit of those who may think I am not. My only object in reading this paper was to attempt to unravel the tangle relative to climate and tuberculosis; a tangle that was made by the ignorant physician both East and West, or by his equally dangerous brother, the commercial doctor. When the millennium dawns, these two enemies of humanity may become extinct, but until that time, like the poor, they will be always with us.

You will note that I have attempted to prove nothing from a scientific standpoint. As a matter of fact, as I told you in the beginning, we have proved nothing. The scientific arguments presented for climate have not held water. We need men with time and money to do real climatic work; to show why better results are obtained here than elsewhere.

At present, we have only clinical impressions and they do not convince the skeptical. We are working in a circle and this leads us nowhere. Some day I hope the impressions gained by men working in favorable climates will be possible of scientific demonstration; but, until that time, let us have done with petty differences, and advise patients intelligently, regardless of whether we live East or West, North or South.

BOOK REVIEW

A Study in the Epidemiology of Tuberculosis, with Special Reference to Tuberculosis of the Tropics and of the Negro Race. By GEORGE E. BUSHNELL, Ph.D., M.D. (New York: Wm. Wood & Co., 1920, pp. 221.)

The author of this work is the well known phthisiologist who for many years was in charge of the army sanatorium at Fort Bayard, New Mexico. His skill in organizing a staff and carrying through a successful examination of the Army during the Great War did much to eliminate tuberculous recruits. His long experience and study of tuberculosis in the mass by virtue of his position, together with an undoubted familiarity with, and study of, the literature of disease in foreign peoples, make this book of especial importance. It is also needed at this time when confusion of ideas on infection in tuberculosis prevails. Sanitarians will find in it wholesome views tending to modify extreme measures for the attempted control of infection. Colonel Bushnell has taken a wide look over the world; no country or island of the seas has failed of his scrutiny where observations on tuberculosis have been recorded. If undue emphasis is here and there evident in his critical analysis of the observations, so much has been brought together in harmony with the conclusions that the reader is compelled to recognize the truth of his thesis even if he questions some of his conclusions.

The conflicting ideas as to etiology both in the pre-Kochian and modern era are presented to show clearly the entire inadequacy of such explanations as climate, atmospheric conditions, inheritance and racial susceptibility. Liberal quotations from French, British and German colonial experience throw these contradictions into sharp relief. After pointing out the necessity in the past three decades of ascribing to predisposition the different types of tuberculosis, the author again demolishes this theory by contrasting the tuberculized races and those but recently exposed to infection.

In no previous work has so much information on the dissemination of tuberculosis among uncivilized, tropical peoples been brought together and the acute infectious character of the disease among them depicted. With the exception of the tropical portions of Asia, the Philippines, Samoa and Hawaii, where the disease has prevailed many years, tropical Africa and the islands of the Pacific exhibit the true primary form of tuberculosis. Japan, China and India have been so long tuberculized that they do not present many more of the acute, primary cases than do the European countries; in fact, the

author comments on the relative infrequency of tuberculosis among the masses of Chinese and Indian populations, when their extreme poverty, poor vegetarian diet and hopeless insanitation are considered. He cites also the experience of Germany during the war, from Colonel Bruns's report on the area occupied by the United States Army. While the tuberculosis mortality has greatly increased, it has not been in the curve of the acute miliary form, but of the more chronic pulmonary cases.

Under modes of infection he considers "that we must look beyond immediate contact with cases of open tuberculosis or their infected surroundings, to account for the practically universal dissemination of the tubercle bacilli under the conditions of civilization."

It is probable that children who live with consumptives are likely to get a more severe form of infection than others not so exposed, but in the latter, besides their getting a smaller dose, he admits the possible attenuation of the bacilli. The statement may be fairly questioned "that the tubercle bacillus retains its vitality almost indefinitely if not exposed to direct sunlight." It may be admitted "that its virulence is somewhat reduced by desiccation," although it is by no means ascertained that such apparent loss of virulence is not explainable by the small number of bacilli remaining alive, thus reducing the dose. Bushnell also recognizes this and believes that one of the blessings of civilization is that we obtain a gradual vaccination against tuberculosis through handling innumerable objects contaminated by a few weak bacilli; whereas the promiscuous life of the savage, eating from a common dish, etc., produces massive infection. The author also raises the question whether the individual who acquires a tuberculous infection, without becoming an open case, may not become a "carrier" as in typhoid fever. If so, this would account for some unexplained infections of unprotected savages.

The studies of Much among the Jews in Jerusalem are quoted at length, where by the cutaneous tests it was found that 90 per cent reacted. Those who came to the city from Arabia mostly failed to react and showed manifest disease when they did respond.

It is thus seen that susceptibility is not racial because the European Jews generally manifest great resistance to the disease. Tracing the history of the infant through childhood and up, the author brings out the well known facts of gradual infection and acquired resistance for the majority of civilized and cleanly adults. He is strongly of the belief that reinfection from outside is rare in adults thus infected and only when primary infection is insufficient is the way open for new infections. There are, broadly considered, only three forms of tuberculosis: (1) Tuberculosis or chronic phthisis in the more or less well immunized subject. (2) Tuberculosis of the imperfectly immunized subject, characterized by large lymph nodes, spreading by lymphogenous extension to the viscera: bones and joints are involved in this form of disease

as well as the skin and serous membranes. (3) Primary tuberculosis as it appears in a young child and natives of countries remote from civilized peoples.[1] Significant histories of certain races now almost extinct are given, to illustrate the devastation that civilized man has often wrought by exploiting the labor of such natives, and even by innocent missionary enterprises. These passages in the book are of absorbing interest and deserve close attention for the lesson they teach.

Where races have not been exterminated by the various diseases of civilized man, a process of gradual tuberculization occurs with the result that the disease becomes more chronic. After the lapse of decades or centuries the forms of the disease are the usual ones met with in cities. Any differences in the clinical course of the latter may be accounted for by environment, habits and privations suffered by the victims, rather than by a hypothetical predisposition, inherited or acquired. It is worth noting in passing that complete confirmation of these views is found in the observations by Colonel S. Lyle Cummins, professor of pathology of the Royal Army Medical College, London, recently published (1) and by Borrel (2). Both writers bring fresh proof of the ravages of acute tuberculosis among Africans, Madagascans and Fiji Islanders who were employed during the Great War.

Under the head of diagnosis, Bushnell gives much space to the tuberculin tests, advocating the cutaneous test on a large scale for the discovery of "unprotected" persons and for epidemiological study. He recognizes the *Stich* and subcutaneous tests as more searching and sees no danger in the latter for inactive tuberculosis: on the contrary it is probably beneficial. Suspected sick persons should not be given the subcutaneous test. A certain number of persons who do not react to high and repeated doses apparently harbor infection, but the well nigh complete tuberculization of adults is recognized from pathological studies. It is not established that infection in adult life, as found in Africans and Pacific Islanders who become tuberculin sensitive, develops an efficient immunity, but it is important to note that they do not immediately develop the disease. This point needs further study upon the natives of the tropics. A great responsibility rests upon physicians when uninfected persons such as groups of laborers are brought into infected surroundings. There are apparently many individuals in country districts who are infected by itinerant peddlers and their wares.

"On account of the almost universal immunization of our race from early tuberculous infection, our sense of tuberculosis as a communicable disease has become blunted." "But tuberculosis," as Hamburger says, "is really as infectious as measles." The author then cites examples of the difference among the natives of Cape Colony before and after it became a health resort

[1] In reverse order, these divisions are similar to those of Karl v. Ranke, based on pathological and physiological studies.

for the tuberculous. A great increase of tuberculosis followed their visits. Examples of the actual opposite condition are found in Davos, Switzerland, and Lippspringe, Germany, where the native death rate declined. Bushnell emphasizes the fact that differences in sputum hygiene do not account for these facts since droplet infection and contaminated objects cannot be avoided. The difference is solely due to the immunity from previous infection of the dwellers of the European resorts.

Prophylaxis then becomes prevention of tuberculous disease and diminution of chances for massive infection so that "the initial dose of tubercle bacilli shall be small. . . . Secondly to improve the health of the community to the end that the immunity gained by a fortunate initial infection shall not be impaired, that vaccination shall not be converted into manifest and dangerous disease." It is inferred that the writer does not favor proceeding beyond these measures in the suppression of the infection at present.

He gives a chapter to treatment of the disease in the tropics and advocates efforts to carry out the usual measures, even in a hot and moist climate, though elevated places are better. Robert Louis Stevenson is mentioned as an example of recovery in a hot climate (though it may be questioned whether he had not recovered long before he went to Samoa).

In referring to the American Negro and Indian the writer disputes the idea that the former was free from tuberculosis until freed from slavery, and he regards the negro as having been already well tuberculized at that time. The great increase of disease since the war must be explained on other grounds, chiefly his disadvantages in industrial and housing conditions and in careless living, diseases, etc. The Indians, however, present a race imperfectly tuberculized or not at all. He gives a vivid picture from personal experiences with Sioux prisoners, of the contrast between the agency Indians, who were much diseased, and the "wild" ones who had not encountered infection. Epidemics of tuberculosis have been reported but are doubted, when chronic disease is the form described.

Under "Practical Considerations" the author mentions the prime importance of protecting infants and children from massive infection. Bovine and human types of bacilli are reciprocal in immunizing power, but he thinks the human infection usually antedates the bovine, which is therefore of little importance and ineradicable in any case. "Civilized man can never escape the danger of infection with the tubercle bacillus." If we succeeded in doing this "we should also lose the benefits of tuberculization." "We are not yet ready for it. . . . The watchword should be: vaccination for all—no manifest tuberculosis for anybody!" He advocates an "artificial, premeditated infection" when the time is ripe to begin it, after further study. A hope is expressed that more delicate tests even than tuberculin may be developed from laboratory study.

In a summary, excellent and thoughtful conclusions are set forth in a logical way, ending with the fervent hope that the time may come when Nature's wasteful method of tuberculization may be replaced by a scientific, artificial inoculation.

The reviewer commends the book to those who are puzzled over the problem of contagion in tuberculosis. It is likely to evolve mingled sensations of fear and thankfulness to read that for our own good we should acquire a little tuberculosis and take our chances that it shall remain dormant. The logical bearing of this principle on health board activities speaks for moderation, less persecution by the public of decent tuberculous patients and fewer cases of cocksure infection of adults from association with such patients.

It seems pertinent to make note of some contemporary theories on the epidemiology of tuberculosis, not touched upon by Bushnell, and propounded by Dr. J. Brownlee (3), statistician of the British Medical Research Committee of the National Health Insurance. On the basis of the decreased tuberculosis mortality in England and Wales, Brownlee finds at least two and perhaps three types of tuberculosis: a "young adult," a "middle age" and an "old age" type. The "young adult" form is more common in the country districts, less where many deaths occur among children, and where milk is much infected etc. The "middle age" group is common where the reverse is true.

Brownlee interprets these findings by assuming, first, the possibility of two distinct strains of tubercle bacilli, one with a predilection for early manhood and possibly also for old age; the other, for childhood and middle life. One is associated with the country, the other with the town. A second explanation places the burden of difference on environment. He admits that one type of organism may give protection against the other, but considers that childhood infection can account for but two-fifths of phthisis in later life, the other three-fifths presumably being acquired from a fresh infection. He leaves the matter for bacteriologists to throw further light upon and states that statistics alone will not give the solution.

These two standpoints mark the transitions that are taking place in medical views of diseases of infectious nature. Much food for reflection may be found in them, and, as Bushnell writes, the wider the survey is made, the more the truths emerge.

E. R. Baldwin.

REFERENCES

(1) Cummins, S. L.: Tuberculosis in primitive tribes and its bearing on the tuberculosis of civilized countries. Internat. Jour. Pub. Health, 1920, i, 137.

(2) Borrel, A.: Pneumonie et tuberculose chez les troupes noires. Ann. d. l'inst. Pasteur, 1920, xxxiv, 105.

(3) Brownlee, J. : An investigation into the epidemiology of phthisis in Great Britain and Ireland. Special Report Series, no. 18, 1918, & no. 46, 1920, Medical Research Committee, National Health Insurance, London.

PULMONARY ATELECTASIS AS A SOURCE OF CONFUSION IN PHYSICAL EXAMINATION OF THE CHEST

HENRY SEWALL

There are several morbid conditions of the lungs which figure frequently in medical speech but relatively seldom achieve anatomical demonstration. One of them is known as *bronchiectasis*, another as *infarct*. Each word stands for a state which is distinctly pathological and comparatively rare as a clinical certainty. The condition which forms the subject of this paper belongs also to the category of things more heard of than perceived; but it is not rare.

Evidence of its existence may probably be found in every healthy lung suffering restriction of activity. It is not primarily a disease, though prone to accompany disease and in itself no doubt represents a large mortality.

Its importance in physical diagnosis depends upon the fact that it may so exactly simulate organic disease within the chest as to deceive not only the tyro but the most experienced examiner. The writer confesses to many personal errors in this field, mistakes which are continually being repeated; and this paper is written not to exploit a new fact but to impress on others a most insidious and often intrusive source of error in conclusions founded on the data of physical examination.

The term *atelectasis* is derived from two Greek words meaning imperfect extension. The facts justify a strict rendering of the etymology; that is, atelectasis does not necessarily predicate a complete collapse and airless condition of the pulmonary alveoli, but also includes any reduction in their volume below that normal to the phase of respiration at which their state is considered.

For practical purposes it is convenient to divide the condition of atelectasis into three stages, which will be treated more fully later.

The first is purely physiological and temporary. It involves any area of the lungs in which inspiratory movement is markedly deficient, as through posture or local inactivity. It requires the exercise of skill in percussion for its recognition and the normal resonance is quickly restored through deep breathing. The second stage of atelectasis

represents a probably more or less complete collapse of the air cells within a definite area determined by conditions limiting expansion of the lung for considerable periods. Thus, when pleural adhesions impair the respiratory excursions on one side of the chest, signs of atelectasis may be detected on that side. Prolonged maintenance of the dorsal decubitus is sure to be accompanied by progressive loss of air in the posterior and basal portions of the lungs. Frequently a relative unilateral immobility leads to a fairly well defined area of dulness in the side of the chest, easily mistaken for evidence of pleural effusion. This degree of pulmonary collapse comes almost daily under the observation of the clinician, but its conscious recognition is probably rare. Its true nature can usually be demonstrated by the rapid transition of an area of percussion dulness into one of resonance through the influence of vigorous respiration or with change of posture. The third stage of atelectasis probably represents a complete collapse of air cells in a considerable area of a lung, so as to simulate closely the condition of consolidation or localized effusion. It has been abundantly proved that for a variable period after a portion of lung has been rendered airless it may be reëxpanded by the insufflation of air; but with continued collapse organic changes supervene, the lung atrophies and it remains a solid mass.

It is usual to divide the clinical occurrence of atelectasis into two groups, the congenital and the acquired. In the first, air cells of the foetal lung have not expanded after birth; in the second, lobules that once have functionated normally later, under influences that will be discussed presently, lose their contained air and collapse through their intrinsic elasticity. Early writers describe such a condition as a local return of the lung to the foetal state. The present article is concerned chiefly with atelectasis occurring in the adult patient, in whom neither its frequency nor its vital importance approaches that of the condition as it obtrudes in the pathology of infants and young children. It is doubtful if any subject in clinical literature will better repay study by the pediatrician than this.

As will presently be seen, most of the research that has been done upon the subject of atelectasis has been concerned with the mechanism of its production. It is expedient that we recognize in advance two essentially different conditions which lead to the establishment of pulmonary collapse. One operates within the pleural cavity outside the lung. It is elementary knowledge that when a hole is made in the chest wall

and the costal pleura, the normal lung immediately contracts to a relatively insignificant mass about the hilum by virtue of its intrinsic elasticity. This extreme collapse does not signify any excess of pressure within the pleural cavity; the pressure within and without the lung are identical. If instead of air, fluid be introduced into the pleural space, the same mechanical relations obtain. Such reduction of lung volume induced from without probably first affects the superficial air cells, the contracting walls of which squeeze out their air; but with progressive collapse of the lung the air cell collapse probably proceeds in a radial direction towards the hilum, the extralobular and intralobular pressures remaining equalized. But Traube long ago demonstrated that even with a wide-open chest and a lung apparently completely collapsed, considerable air was still confined within the organ, for a portion excised would float in water. Only after resting an hour or more would the tissue become completely airless. The apprehension of these mechanical relations is not without value to the clinician who so often has to consider the hydrostatic effects of pleural effusions. Especially in recent years, when the therapeutic application of artificial pneumothorax has become a daily procedure, it would seem important to trace the course of the functional and structural changes in the collapsed lung.

As will be noted presently, the recently collapsed lung maintains for a considerable interval its organic integrity and may be completely reëxpanded by the insufflation of air under pressure.

Considerable research has been devoted to the determination of the physiological and mechanical changes in the collapsed lung as a basis for the understanding of the conditions of development of pulmonary tuberculosis. The most recent work in this field is described in a recently published study by Corper, Simon and Rensch (1).

These investigators studied in rabbits the effect of unilateral collapse of the lungs on the distribution of various media, emulsions of tubercle bacilli, starch, Prussian blue, etc., introduced by the vein. They reached the conclusion that neither the quantity nor the local distribution of the injected material in the two lungs was altered by experimental collapse of one of them whether the injection preceded or shortly followed the induction of collapse.

Corper and Rensch, continuing this line of research, found that

Prolonged artificial pneumothorax in rabbits, sufficient to produce a good collapse of the right lung, initiated shortly after the intravenous injection of

a suspension of virulent human tubercle bacilli and maintained for a period of a month by means of the intrapleural injection of air every second or third day throughout the experimental period, has no appreciable effect upon the size or number of macroscopic tubercles found in the lungs of the treated animals as compared to the untreated (controls), or in the compressed right lung as compared to the noncollapsed left lung.

They found, also, that when pneumothorax was established as described and was maintained for a period of two weeks, a suspension of scarlet R, then injected intravenously, was distributed fairly equally in the two lungs. When, however, a like injection was made in a rabbit whose right lung had been maintained in collapse for four weeks there was appreciably less pigment found in the collapsed as compared with the expanded lung.[1]

It is important to observe that in the clinical collapse of the lung under induced pneumothorax the lung is probably completely quiescent only for brief periods. With progressive absorption of the gas introduced the affected lung must indulge in more and more ample respiratory excursions, so that structural changes within it may be indefinitely postponed.

Nevertheless, sooner or later structural changes certainly ensue in the airless organ, as was once illustrated to me in the person of a young adult Japanese. The patient had evidently long carried a massive serous effusion within the right pleural cavity. The fluid quickly reaccumulated after each of repeated aspirations. Death followed some acute infection and autopsy revealed, as my memory represents it, a right lung reduced in size to a solid nodule less than half the size of and about the same consistency as a normal kidney, fast to the hilum, red in color, smooth in outline and nearly globular in shape.

HISTORIC CONSIDERATION OF ATELECTASIS

Few subjects in medicine could from a pedagogic point of view better repay historical research than that treated in this sketch. The condition of atelectasis was first clearly designated in 1832, and for a score of years it occupied a prominent place in medical literature. Thus, Condie (2), in the fifth edition of his textbook published in 1858, gives a good account of the whole subject; and B. Bischoff (3), in 1854 devotes thirty

[1] Personal Communication. Since the above was written this work has been published in The American Review of Tuberculosis, 1920, iv, 769.

closely printed pages to an encyclopaedic discussion of all phases of atelectasis. But in the two decades centered round the beginning of this century all mention of the subject was omitted from most English and American works devoted to physical diagnosis.

Even in Weil's classical monograph on percussion (4), with pages devoted to methods for the determination of the lung boundaries, I can find no reference to the important modifying influence of atelectasis. Much that had been learned and was worth remembering was later forgotten.

The reader of the early literature on this subject cannot but feel enthusiasm for the exhibition of trenchant pathologic observation, acute clinical perception and logical analysis of facts, set forth in scholarly language and with graceful acknowledgment of foreign colleagues, which characterized the writers of those days.

The English student will be repaid for a study of the works of West (5), Gairdner (6) and Willshire (7). West writes:

> Imperfect expansion of the lungs presents itself to us in two different circumstances: first, as a congenital condition, a more or less considerable portion of the lung never having become penetrated by air, but having remained in its foetal state. Second, as an acquired condition: portions of the lung which once were freely traversed by air ceasing to admit it; and this not from alteration of structure, but from simple collapse of the pulmonary tissue.

The first clear description of the former of these conditions was given, in a dissertation in Latin, by E. Jörg, in 1832. He constructed the name *atelektasis* to designate imperfect expansion of the pulmonary tissue. Nevertheless, as quoted by West, already in 1814, a Frenchman, J. A. Troccon, had maintained that discrete areas of pulmonary consolidation found in a certain systemic disease were not due to lobular pneumonia but to a simple alveolar collapse, and proved his contention by causing the consolidated areas to expand in a normal manner by blowing air into the trachea. Troccon failed to grasp the broad significance of the facts discovered by himself, and it was not until thirty years later that they were rediscovered and their bearing fully elucidated by two other Frenchmen, Legendre and Bailly (8). These investigators protested against the diagnosis of an inflammatory lobular pneumonia so often given as cause of death in debilitated infants and they rightly held that the current antiphlogistic treatment by bleeding was contraindicated. They said that in infants which have been long enfeebled

the lungs often contain after death a certain number of consolidated lobules. This airless condition of the lobules may occur in the absence of all inflammation but it usually develops after the advent of bronchiolar obstruction caused by pulmonary catarrh of whatever origin. Another cause of lobular collapse is pressure of the blood accumulated in the vessels surrounding the air cells. This condition is usually found along the posterior borders of the lungs and probably corresponds to what students of today know as hypostatic pneumonia a result of the decubitus. Whatever the cause of the consolidation, its differentiation from exudative lesions which obliterate the air cells is accomplished by blowing air into the trachea, whereupon the contracted lobules reëxpand more or less to the normal state. This lobular collapse, they said, is very frequent between the ages of two to five years, then becomes rare, but increases again in old age.

Nearly ten years elapsed before the condition of atelectasis was again submitted to critical clinical-pathological investigation by Gairdner (6). This observer sustained the conclusions of Legendre and laid special stress upon the causative relation of bronchial obstruction to pulmonary collapse. Such obstruction, he claimed, was never complete. The plug of mucus acted as a ball-valve, permitting air to escape from the alveoli during the movement of expiration, but preventing its return during inspiratory expansion. Speedy collapse of the air cells was a necessary consequence. We cannot here analyze the evidence for this interesting conception but, curiously enough, more than half a century after Gairdner's work, Dixon and Brodie (9), in extensive experiments on the dog, cat and rabbit, obtained results which are possibly confirmatory of Gairdner's hypothesis. These investigators studied the volume changes in the lobe of a lung inclosed within a plethysmograph and supplied with artificial respiration. The important discovery had been made that the muscles of the bronchioles are innervated both by constrictor and dilator fibers travelling in the vagi. They found that, when a part of the lung was rhythmically ventilated under moderate air pressure, contraction of the bronchioles led to gradual collapse of the part of the lung under observation. That is, air escaped from the alveoli when the air pressure was relaxed (expiratory movement) but constriction of the bronchi prevented inflow of air under moderate (artificial inspiratory) pressure. A steady collapse of the lung therefore attended the movements of artificial respiration. The bronchial constriction could, however, be overcome by sufficiently increasing the

force of the ventilating current. When this occurred the air cells remained continuously distended because the elastic recoil of their walls was not strong enough to overcome the bronchiolar contraction. Although under artificial respiration intrapulmonary air pressure is greater in inspiration than in expiration while in normal respiration it is less, these experiments point to the conclusion that plugging of the bronchioles under clinical conditions induces atelectasis by valvular action of the mucoid obstruction though, as will be seen presently, Lichtheim offers a different explanation. Furthermore, it is of paramount importance to apprehend that, in the clinical states characterized by atelectasis, deficiency in the force and depth of inspiratory movement is a nearly constant condition.

That experimental plugging of a bronchus was quickly followed by collapse of the corresponding part of the lung was shown in 1871 by Traube (10) who inserted wads of paper into the bronchi of animals. The radiographer of to-day has frequent opportunity of demonstrating the apparent pneumonic consolidation of a pulmonary lobe, especially in children, which soon follows the accidental aspiration of a foreign body, such as a bean or peanut, which slips into a bronchus, swells and occludes it.

The next, and apparently the most recent, investigations of the cause of pulmonary collapse which follows occlusion of a bronchus were carried out by Lichtheim (11) in 1878. This experimenter rejected the ball-valve theory of Gairdner, according to which during the movements of respiration air escaped from the alveoli past an obstruction which was partial during expiration but which became complete and prevented refilling of the air cells when the current was reversed. Lichtheim carried out an extensive series of experiments on rabbits, the conclusion from which was that all forms of atelectasis, that due to bronchial occlusion, as well as that following opening of the pleura, are caused by absorption of air from the air cells by the blood circulating in their walls.

These results deserve especial attention since they appear to have been accepted without question by recent writers and to have determined the modern view.

Lichtheim appears to have proved beyond dispute that complete obstruction of a bronchus, or of a branch thereof, was soon attended by complete collapse of the corresponding pulmonary area, and he made it well nigh certain that the atelectasis was due to the absorption

of air by the circulating blood. But he did not disprove the contention that the air cells might be emptied through a ball-valve action of a bronchial plug during respiratory movement. On the contrary, Lichtheim himself found that when he occluded a bronchus with a laminaria plug or by a tight ligature and left the wound open to observe the process of atelectasis, collapse did not occur or was much delayed; and the death of the animal usually supervened while the lung continued to hold air. But if, after occluding the bronchus, the external wound was closed and the animal was freed from the holder, it was found, by occasionally reopening the wound and inspecting the lung, that atelectasis rapidly progressed and after an average interval of three hours the air was completely absorbed from the lung.

It will be noted that in the first case, with opened thorax, there could have been no respiratory movement on the part of the obstructed lung, while in the second case, with the thorax closed, there must have been some, if slight, expansion and contraction of the lung with inspiration and expiration. This view is supported by the author's statement that absorption was notably quicker in lungs which were partly collapsed at the time of bronchial ligation than in those which were distended at the outset.

The author's explanation of the difference as dependent on the drying of the parts in the open thorax is not wholly satisfactory. Lichtheim studied the rates of absorption of air and of its single components from occluded portions of the lung. He found that carbon dioxide or oxygen alone was absorbed much more quickly than air but that nitrogen was absorbed more slowly than air. In favorable circumstances atelectasis would supervene in thirty minutes after bronchial occlusion. Where air or nitrogen was insufflated the lung might still contain gas after four to nine hours. It is noteworthy that the absorption of carbon dioxide from the air cells was as rapid as that of oxygen, if not more so. It seems possible that some local pathological condition of the tissue juices might partly account for the absorption of these gases.

THE PHYSIOLOGICAL BASIS OF ATELECTASIS

Turning now to the human subject under either physiological or clinical conditions, it may be plausibly assumed that temporary collapse of various areas of the pulmonary parenchyma is of frequent and normal occurrence, just as it has recently been made probable that ordinarily

great numbers of the vascular capillaries are collapsed and empty of blood. The demonstrable fact that the lungs, even during extreme inspiratory expansion are never, within the closed chest, distended to their utmost should make it obvious that the relaxed tissues of the poorly expanded lung would more or less fold together and tend to obliteration of minute air tubes traversing them. Measurements in the human organ have shown that the smallest air cells have a diameter of 1 mm. The terminal bronchioles arising from these have lumina of 0.18 mm. to 0.22 mm. diameter (12). The stem into which two bronchioles unite has a lumen of less capacity than the sum of the latter. Considering the normal moisture of the living epithelium, let alone the presence of exuded mucus, it is to be expected that in the absence of fairly vigorous ventilation a certain degree of bronchiolar occlusion must be of common occurrence with sedentary subjects and constantly present in most bedridden patients. Accordingly more or less extensive atelectatic collapse of air cells must be expected in those regions of the lungs which are less subjected to inspiratory expansion.

It is highly probable that the condition of atelectasis, as such, is seldom recognized. Only when the examiner definitely *thinks* atelectasis will its signs usually be correctly apprehended, and will then be common enough. The existence of atelectasis is recognized clinically through auscultation or percussion or both combined. Every careful student of physical diagnosis must have noticed, now and then, in the normal subject, a change in the resonance of the percussion note as a result of change in posture or of vigor in respiratory ventilation. At the beginning of a physical examination it is common to find a relative percussion dulness to characterize a restricted area of the chest, with the underlying breath sounds enfeebled but essentially normal in quality. After a few vigorous strokes the percussion dulness gives way to normal resonance and the respiratory murmur increases in volume. The quasiconspiracy of silence that marked the attitude of clinical observers for more than half a century was first broken by Albert Abrams of San Francisco. This author (13) has repeatedly insisted on the prevalence and importance of the atelectatic state not only as a pathological but as a physiological condition of the pulmonary alveoli. As early as 1894 (14) Abrams wrote, "Even in a state of health the lungs are imperfectly aerated and in a condition of physiological atelectasis."

This author, recognizing the islands of percussion dulness sometimes encountered in exploration of the normal chest, finds them to quickly

develop a resonant note, not only through forceful percussion but after the application of any stimulus, whether electrical, chemical, thermal or mechanical, to the overlying skin. He names this reaction the *lung reflex of dilatation*, and implies that expansion of the air vesicles takes place through the operation of a reflex arc.

It may be remembered that Dixon and Brodie (9), and others, produced experimental evidence that the vagus nerve carries both dilator and constrictor fibers to the bronchiolar muscles which might well react to peripheral stimulation of the skin. But it is not clear how bronchiolar dilatation alone could cause expansion of the air cells except when accompanied by deepening of the inspiratory movement. Nevertheless, the writer in testing this point, after the crude clinical method, has seemed to find a dull area clear up under percussion without simultaneous change in the amplitude of respiration. Abrams locates definite peripheral areas, the irritation of some of which constantly causes reflex contraction, while stimulation of others as specifically causes dilatation of the air cells. His ingenious observations are however unfortunately interspersed with such transcendental points of view that it is difficult to estimate their value (15). There is enough evidence for a reflex control of the bronchial musculature (as in the admitted bronchial spasm resulting from irritation of the mucous membrane of the nose) to demand a thoroughgoing physiological reëxamination of the whole subject.

THE CLINICAL RELATIONS OF ATELECTASIS

The foregoing review has been thought desirable to provide a more stable basis for the clinical appreciation of atelectasis.

My own conception of the subject only became focused a few years ago under the influence of a spectacular incident. A little boy of six years had been through a long and critical illness with typhoid fever. Every therapeutic device seemed to fail until the lad was subjected to a state of nearly absolute physical repose. Under this treatment there was gradual improvement, and hope of recovery was strengthened. On a certain day there was a slight rise of body temperature and a physical examination was instituted, the first in many days, to elucidate the febrile rise. I found the percussion note over the front and side of the left chest quite flat in quality. Suspecting a purulent effusion, the boy was quickly turned on his right side and made to breathe deeply while thorough examination was made of his back. An exploratory needle

inserted at the left base disclosed no fluid. The dulness here gradually cleared up under percussion and the auscultatory signs became normal. Returned to the supine posture, the front of the chest now showed the normal puerile percussion resonance. It may be added that after the manipulations described the condition of the little patient became progressively worse and he died in the course of a day or two. It seems highly probable that mobilization of toxic stores through the unwonted vigor of respiratory movement was responsible for the exitus.

It is believed that bedside experiences such as the foregoing are by no means rare. A well known scientific clinician, Sir James Barr, in a valuable paper including the subject of this sketch writes as follows (16):

> Especially in many wasting diseases, where the demand for oxygen is not great, ... partial atelectasis of one or both lungs, or almost complete atelectasis of one lung, is not at all uncommon. It is especially apt to occur in young, flat chested individuals with pliant chest walls. . . . . These cases are frequently overlooked because there is usually a negation of subjective chest symptoms, and so the lung is allowed to remain so long collapsed that it never completely expands and afterwards the deficient expansion of one side of the chest is supposed to be the result of some old pleural effusion, of which the patient has no recollection. When these cases are discovered in the early stages they are usually mistaken for pleural effusion, an error which is apt to remain uncorrected if an exploring needle be not inserted in the chest. . . . . I have seen this condition occur in typhoid fever, infective endocarditis, pyaemia, etc.

He recalls a consultation with a medical attendant who supposed that empyema had developed in a case of typhoid fever, but the morbid signs were shown to be due to alveolar collapse. Barr relates a mistake made by himself in the case of a boy confined to bed after excision of tuberculous iliac glands. "I found the right side of the chest absolutely dull from base to apex, absence of respiratory murmur and no vocal phenomena. I rapidly came to the conclusion that the right pleura was full of fluid." Several punctures were made with negative results and the youth got well under a course of respiratory gymnastics.

The treatment advised by Barr was that the patient should lie on the sound side of the chest, with the addition, when expedient, of respiratory exercises. It is worth noting that, while it seems selfevident that pulmonary ventilation must be most vigorous in the upper as compared

with the lower lung, when a patient lies on his side, this is obvious only as regards the costal respiration. According to L. Hoffbauer (17), "The roentgen rays have shown that when reclining on one side, the half of the diaphragm on the under side is drawn high up and makes exceptionally extensive excursions, while the half of the diaphragm on the uppermost side makes exceptionally small excursions."

Every physician experienced in pulmonary tuberculosis has been confronted with the dilemma presented by misleading signs of pleural effusion due to atelectasis. But there is no Ellis curve capping the area of flatness. The affected side is *contracted* rather than expanded.

There is no bronchial breathing or voice as in cirrhosis. The aspirating needle gives a dry tap. There can be little doubt that the condition is one of pulmonary atelectasis. In my experience this congeries of signs is especially apt to be found at the base of the left lung in chronic cases of long standing. The obvious explanation for this localization, as due to pressure of the left auricle and of the pulmonary artery, perhaps deserves investigation. I have often been impressed by the occurrence of temporary percussion dulness, in the absence of effusion, occupying the lower third or more of the left side of the chest. The dulness is maintained in the upright and supine postures, but usually clears up when the patient turns on the right side or breathes deeply. It can be explained as due to atelectasis after excluding the signs attributable to spleen, liver and stomach contents.

Recently a boy of twelve, living with a tuberculous mother, suffered severe pain from an acute pleurisy at the base of the right lung. After a week in bed the boy was apparently well, but now percussion flatness involved the lower two-thirds (or more) of the right chest, together with other signs of effusion. Puncture with a large exploratory needle disclosed no fluid. The patient cried much and breathed deeply during the operation; and immediately thereafter percussion of the right chest disclosed a dull tympany, so that for a while it was feared that I had caused a traumatic pneumothorax. The boy got well with diminishing signs of effusion.

A man of early middle age, who had recently recovered from an appendicectomy, suddenly expectorated a large amount of foul pus. Subphrenic abscess was suspected, with rupture into a bronchus. As the patient lay on his back rather dense percussion dulness, with a horizontal boundary, marked the undermost half of the right axilla. Exploratory puncture was negative and later an X-ray photograph of

the chest in the upright posture showed the pleural cavity to be contracted but free from fluid.

The physical examiner is wont to overestimate the depth beneath the chest wall to which percussion and auscultation extend their informing signs. It is not unknown for the X-ray plate to disclose a relatively huge mass occupying the centre of a lung, the existence of which has been missed by expert examiners. According to Weil (4), where the chest wall is moderately thick no percussion vibration can penetrate the lung more than 4 cm. ($1\frac{3}{5}$ inches) in a vertical direction or, measuring from the outer surface, can reach to a depth of more than 6 cm. ($2\frac{1}{5}$ inches). The localization of the source of morbid signs by auscultation is often a difficult or impossible procedure.

But perhaps by far the commonest evidence of atelectasis is elicited during auscultation rather than percussion. Let us suppose the superficial air cells in a quiescent portion of a lung to be collapsed, percussion fails to detect any definite evidence of consolidation, but the first deep inspiration opens those cells to ventilation and the examiner hears crackling râles, which often have a considerable degree of moisture.

Only recently I examined a young woman in whom four years before a tuberculous lesion, limited to the right apex, had been detected. The recent examination disclosed no marked percussion dulness over the front of the chest below the second rib, but on the right side abundant coarse crackling râles were heard from the clavicle to the liver; and below the second rib there was a sharp, highpitched inspiratory murmur. The instant conclusion was that the patient had entered on a serious relapse with marked extension of her disease. After a few deep breaths all râles disappeared from the front of the chest below the second rib, a few crackles only persisting in the lower right axilla. The fleeting morbid signs were evidently due to atelectasis and the example is cited as a key to common and confusing experiences. The peculiar highpitched inspiratory murmur noted at the initial opening of the collapsed air cells has special significance since it may have the same origin as a similar murmur which frequently characterizes inspiration in various morbid states of the lung.

A young man with chronic, stationary tuberculosis of the upper lobes developed, during the recent epidemic of influenza, signs and symptoms of inflammation at the base of the left lung. Subsequent rigorous examination was purposely intermitted until the lapse of a few days, when the patient had become symptomatically well. Then, for the

first time, auscultation over the left base disclosed showers of fine crepitations precisely like those usually found at the outset only of influenzal pneumonia. The rapid reëstablishment of a normal respiratory murmur indicated that the râles were atelectatic. It may be suspected that the wonderful improvement which the practitioner of medicine so frequently finds in the physical signs of a newly acquired tuberculosis case at the second examination has much to do with the dissipation of atelectasis through the gymnastics of the first.

Colonel Bushnell has insisted on the prevalence and harmless significance of marginal râles, frequently heard with inspiration along the lower margins of the lungs. In his excellent protocol for the pulmonary examination of recruits for the army in the recent war he takes great pains to point out that the occurrence of such râles is no evidence of tuberculosis. Bushnell (18) thinks that the sounds are due to vibrations set up by separation of the more or less gummy surfaces of the costal pleura and margin of the diaphragm as the latter descends in inspiration. Probably a more efficient cause of the phenomenon is that given by Cabot (19), namely, that the crackling depends upon the opening of collapsed air cells as the lung follows the diaphragm.

DISCUSSION AND CONCLUSIONS

This paper exploits no new facts. It is simply an attempt to dust off, rehabilitate and show the value of paraphernalia that most clinicians have cast into a neglected corner.

In the psychology of physical diagnosis nothing is more certain than that our apprehension of a patient's condition depends not on what we know of physical signs but on what we consciously apply to the subject under investigation.

If the examiner but *thinks* atelectasis, bears in mind the conditions of its occurrence and applies the simple tests for its recognition, physical diagnosis of the lungs will gain much in certainty.

Reflection breeds speculation and speculation leads to understanding and discovery.

The data detailed above, weighed against the evidences of clinical tuberculosis, presents certain paradoxes that need elucidation. The older writers agree that persistent foetal or adolescent atelectasis is prone to be accompanied by the development of tubercle in the collapsed areas.

The radiographer, with the fluoroscope, habitually finds, even in healthy lungs, a certain depth of shadow, indicating relative collapse, in the apices under quiet breathing which is dissipated after deep inspiration. As it is in the apices that tuberculosis apparently finds its least parenchymal resistance, the conclusion might seem plausible that the atelectatic condition distinctly favors the development of tuberculosis. But at least two other conditions are to be considered besides collapse of the air cells in explaining the predilection of tuberculosis for the apex. One is the lessened gas exchange and reduced respiratory movement and the other is the local blood supply. In their work already quoted, Corper and his colleagues would seem to imply that no great circulatory change pertains to the condition of pulmonary collapse; but Phillips (20) has recently plausibly argued that the involvement of the apices of the lungs in the tuberculous process is specifically invited by the relative anaemia of those parts in man induced by the gravitation of blood while in the upright posture.

It would seem self evident that, as the main or sole business of the lungs is to serve as an organ for gas exchange, any restriction of their functionating area must be regarded as unphysiological and liable to invite disease. It is a popular impression, for which there is some evidence, that pulmonary tuberculosis is especially liable to attack athletes after they abandon vigorous exercise and assume a sedentary life. In such a case it seems probable that redundancy of pulmonary tissue would lead to excessive atelectasis.

But we must allow no speculation to loose our hold on the hard-won secret of tuberculosis therapy, that active disease demands rest for the affected part and that, when pathological activity is threatened, exercise must be graduated with extreme caution. Perhaps the truth may be condensed in a therapeutic formula: Rest saves life, exercise makes well.

There is no difficulty in conceiving that an active tuberculous focus works its deleterious influence through the toxins it sheds, and that the inimical effects of bodily exercise depend largely, if not wholly, upon its favoring mobilization of the poisonous output. But we do not usually entertain the complementary view that a healthy tissue, in proportion to its functional activity, may possibly also serve as a source of circulating products which, after the manner of hormones, enhance the conservative and resistance powers of the body. If this were not so, it is difficult to explain the known fact that in a case of bilateral pulmonary tuberculosis in which the disease is nearly equally distributed, artificial pneumothorax applied to one side very often results in speedy

amelioration of symptoms and ultimate arrest of the disease. We must admit that the exaggerated activity of the functionating lung favors the dissemination of toxins from it; but, if we grant that the more thorough ventilation of the lung results in unfolding and unwonted activity of healthy air cells hitherto little used, we may assume such an increase in the output of what may be called antiseptic products from the healthy as compared with the mass of septic excretes from the diseased tissue that the balance enhances the physiological reactions of the protoplasm at large. Obviously so fundamental a conception can at present be formulated but crudely; nevertheless a useful working hypothesis may inhere in the thought that living matter may have its aggressins of health as well as of disease. It is interesting to note that such a view is already adumbrated in the literature. By implication it is a keynote of Abderhalden's dissertation on *Protective Ferments* (21), and quite recently Leo Loeb (22) has formulated the complementary view that the normal body cells send off products which in certain other cells stimulate proliferation and promote the formation of cancer.

Perhaps a more plausible explanation of the clinical improvement, so often manifested by cases of severe bilateral tuberculosis after more or less complete artificial collapse of one lung, is to be found in a possibly excessive hyperaemia of the other. In experiments on rabbits Bruns (*Deutsch. med. Wchenschr., 1913, xxxix, 101*) found that the volume blood flow through the collapsed lung was lessened, and in a degree proportional to the completeness of collapse. Obviously, then, a correspondingly increased portion of the current in the pulmonary artery must have been diverted to the expanded lung.

It has long been a standard clinical belief that the development of tubercle is opposed in areas of congestion. I have observed a large number of X-ray plates from cases of advanced tuberculosis in which artificial pneumothorax had been performed. As a rule, the picture taken after the operation shows in the more expanded lung a decided increase of opacity in the background as compared with the picture obtained before the operation. While admitting the important sources of error in such comparisons, the suspicion may well be entertained that the increased opacity manifested in the lung opposite the side of the puncture is due to its plethora, and that this plethora may counterbalance the evils otherwise inherent in exalted activity of the diseased organ.

The practical data of atelectasis may be summarized as follows: 1. A relative degree of atelectasis, partial collapse of the air cells, occurs

normally in any pulmonary area which is not habitually undergoing fairly vigorous ventilation: it is favored by feeble and opposed by vigorous inspiratory movements. In proportion as the vigor of respiratory aeration is diminished the pulmonary collapse becomes more extreme. 2. Collapse may be determined either by compression from without or blocking of the bronchioles within the lung. 3. Lobules of the lung which have recently become airless may, by inflation, be completely restored to their original condition; but after prolonged collapse, of indefinite period, organic changes supervene which render them incapable of expansion. 4. Minor degrees of atelectasis may be denoted clinically by the demonstration of circumscribed areas of relative percussion dulness which quickly acquire normal resonance after deep breathing or with change of posture; or by the advent, with deepened breathing, of inspiratory râles which quickly disappear under respiratory exercise. Collapse of an extensive volume of pulmonary tissue is denoted by contraction of the overlying chest wall combined with physical signs simulating those of consolidation or of an encysted pleural effusion. 5. The physical signs of atelectasis owe their diagnostic importance to the fact that they are apt to be developed in just those conditions in which we are justified in expecting the advent of organic lesions whose signs they imitate.

REFERENCES

(1) Corper, H. J., Simon, S., and Rensch, O. B.: Amer. Rev. Tuberc., 1920, iv, 592.
(2) Condie, D. F.: Diseases of children, fifth edition, 1858.
(3) Bischoff, B.: Handbuch der Kinderkrankheiten, 1854.
(4) Weil, A.: Handbuch und Atlas der topographische Perkussion, 1880.
(5) West, C.: Diseases of infancy and childhood, fifth English edition, 1868.
(6) Gairdner, W. T.: Brit. & Fr. med.-chirurg. rev., 1853, xi, 354.
(7) Willshire, W. H.: Ibid., 1853, xii, 400.
(8) Legendre and Bailly: Arch. gen. d. med., 1844, pp. 55, 184, 286.
(9) Dixon, W. E., and Brodie, T. G.: Journ. Physiol., 1903, xxix, 97.
(10) Traube: Gesammelte Beiträge, 1871 (quoted from Lichtheim).
(11) Lichtheim: Arch. f. exp. Path. u. Pharmakol., 1878, x, 54.
(12) Vierordt, H.: Daten und Tabellen, 1906, p. 128.
(13) Abrams, A.: The blues (splanchnic neurasthenia); 1904. Spondylotherapy, 1910.
(14) Abrams, A.: Clinical diagnosis, 1894.
(15) Abrams, A.: Med. Rec., February 16, 1918, 276.
(16) Barr, J.: Brit. M. J., 1907, ii, 1289.
(17) Hoffbauer, L.: Abstr. in Jour. A. M. A., 1914, lxiii, 1242.
(18) Bushnell, G. E.: Osler's jubilee, vol. i, 368.
(19) Cabot, R. C.: Physical diagnosis, 1905.
(20) Phillips, W. F. R.: Med. Rec., 1919, xcvi, 265.
(21) Abderhalden, E.: Abwehrfermente des tierischen Organismus, 1913.
(22) Loeb, L.: Am. J. Med. Sc., 1920, cliv, 781.

EXTRAPLEURAL THORACOPLASTY

AND A MODIFICATION OF THE OPERATION OF APICOLYSIS, UTILIZING MUSCLE FLAPS FOR COMPRESSION OF THE LUNG

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I imagine that not since Brehmer revolutionized the treatment of pulmonary tuberculosis with his sanatorium idea, and his programme of what we now call proper hygienic measures, has there been made any advance in the treatment of the consumptive more productive of good to the patient, or more sound in principle, than Forlanini's method of artificial pneumothorax. It is now generally considered a definite fault of omission to neglect this procedure in the proper kind of case. Upon the basis of the knowledge gained through the practice of the method there was built, some fifteen years ago, the plan of Brauer and of Friedrich, which consists in imitating the method of artificial pneumothorax, where that is not possible, by removing a sufficient number of ribs to allow the chest wall to fall in, and thus, to some extent, to bring about a collapse of the lung itself. It is not my intention here to trace in any detail the development of this branch of surgery. I have no doubt that in any case it is fairly well known to all of you. The very extensive removal of ribs, involving practically the whole of one side of the chest, as at first advocated by Friedrich, was soon abandoned on account of its high mortality. (Three years ago I reported before this Association my first two cases of thoracoplasty, of which the first was done according to the Friedrich plan, the patient dying in six days from oedema of the other lung and failing heart.) Wilms then published, in 1911, his method of columnar resection, which meant the removal in one, two or three stages, of small portions of all the ribs from the second to the tenth behind, and, sometimes, also the resection of the upper five or six ribs in front. This method has remained, with a few modifications, the standard of thoracoplastic operations. Its mortality has been comparatively small. It has been modified, in details of incision and length of ribs resected, by Sauerbruch; and Sauerbruch's method is now generally adopted.

It soon appeared, however, that that type of lesion, which consists chiefly in extensive apical disease with cavity well up in the upper lobe, was not sufficiently influenced, in the sense of compression, by mere resection of ribs, even when the first rib and the clavicle were included in the resection. The "spring" is obviously much less at either end of the barrel than it is in the middle. The break in the clavicle also carried with it considerable disability and deformity from dropping of the shoulder. Under these circumstances Freeman, of Denver, in 1909, after resection of the upper ribs in front, advised the early application of an ordinary spring truss, going over the shoulders, of which the pad was to lie below the clavicle, with the idea of directly compressing the apex.

In the following year Tuffier, of Paris, in 1910, devised his operation of apicolysis with the object of securing compression of the apex and the upper part of the upper lobe. This consisted briefly in the resection of one or two inches of the second rib in front, with peeling off of the parietal pleura from the inner surface of the rib. This was accomplished gradually with the finger up over the apex, down over the sides, and down over the back, until the whole upper part of the lobe was liberated, thus leaving a moderately large cavity in the upper part of the thorax. To prevent reëxpansion, and to keep up compression, Tuffier filled this cavity with a free transplant of fat taken from the abdomen. Excessive precautions in the matter of asepsis and haemostasis had to be taken to insure the toleration of the graft. His last reports upon the method, so far as I can discover, are to be found in a long article upon thoracic surgery, which he read before the International Medical Congress of 1913, in London, and in an article in the *Interstate Medical Journal* (translated) in early 1914.

In 1913 Baer, in Switzerland, proposed the filling of the apical space with melted paraffin, and this method was used in a fair number of cases by Sauerbruch. The prime object of both these methods was to localize compression to that part of the lung which was chiefly, or alone, diseased, and thus to obviate, in such cases, the more extensive operation of columnar resection. The results were on the whole encouraging; yet one must point out that neither substance, fat or paraffin, can be considered ideal. Whether the fat transplant lives and preserves for any long time its original bulk is not known and must remain dubious. One would rather expect it to undergo at least partial liquefaction, with consequent diminution in size and in compression value. More-

over fat is peculiarly nonresistant to infection, which must always be feared. As to paraffin one can urge that it is a foreign body, and that in a considerable percentage of the cases in which it has been used it has ultimately been extruded. Henschen reported, in 1914, that in somewhat over 20 per cent of the cases of paraffin filling failure resulted, usually on account of infection. In Baer's original case, upon which he based his report, infection occurred apparently through necrosis of the thin covering wall of the cavity by too great pressure of the unyielding paraffin, which had to be removed, leaving an annoying tuberculous sinus.

Considering all this, it seemed to me desirable to find some other method of exerting compression. My original idea was, after separating the apex and pressing it down, to bring a flap of the pectoralis major from in front, and of the trapezius or perhaps the rhomboid from behind, and to unite these flaps over the apex and under the clavicle and first rib, so as to form a sort of stirrup, as well as a simple mass of muscle, which would probably maintain compression permanently both by its mere bulk and also, possibly, through actual tonic contraction of the muscle fibres. On second thought, however, I decided to see first what could be done in front with the pectoralis major and minor; and the more so as too extensive an operation might be unsafe for the patient. It seemed, however, probable that in all cases, except those of very limited disease in the apex, the best results could only be obtained by combining, with the muscle implant, a posterior columnar resection. The chief advantage of muscle, regarded as a filling material, lies in the fact that it remains a living tissue inasmuch as pedunculated flaps can be fashioned so as to insure nutrition. Moreover the bulk that can be obtained is large, and amply sufficient to fill the space created by apicolysis. It may be urged that the muscle might undergo atrophy, to a certain extent, from disuse; but the amount of muscle available, to judge from my experience, seems quite sufficient to allow for some atrophy without too great a sacrifice of its compressing value. A further advantage of muscle lies probably in the fact of its well known resistance to infection. I have the impression that muscle, like peritoneum, is able actually to overcome a moderate infection. With this plan in view I proceeded to perform the operation on the patient whose case report I may now relate.

Case 1. The patient, S. R., aged twenty-eight, was quite well up to March, 1912, when he took what was considered to be a severe attack of grippe, which

lasted three weeks and was followed immediately by cough and expectoration. A little later he had chills and night sweats, and his doctor shortly afterward made a diagnosis of pulmonary tuberculosis. In May, 1912, he was sent to Muskoka, where he ran fever for thirteen months. There was gradual improvement through the fall and winter. In March, 1913, he had a fresh cold, together with cough and increased expectoration, lasting three months. In the summer of 1913 he was fairly well and gained weight. During 1914 he continued to take the cure and, although unable to work, improved slowly and was largely without fever. In January, 1915, there occurred another flareup with fever and increased sputum. During the summer of 1915 he improved again; but in September a cavity in his left upper lobe was discovered. There was mixed infection in this and he was given a "serum" for several months. In January, 1916, he was sent to Dr. Parfitt, of Gravenhurst, who allowed him slight exercise and said his lung was fairly quiet.

In February, 1917, there was an increase in fever, pulse and sputum, and he began to have some digestive disturbance, with loss of appetite and of weight. In the spring of 1917 Dr. Parfitt attempted to establish an artificial pneumothorax, but was obliged to give it up after eleven unsuccessful attempts. Obviously the pleura was obliterated by extensive adhesions. During all of the latter half of 1917 he was greatly troubled with cough and copious expectoration, so that finally, in the late fall, Dr. Parfitt suggested a thoracoplasty, to which he consented, and Dr. Parfitt then sent him to Montreal under my care. His physical findings on admission were briefly as follows: His general condition appeared fairly good. There was slight evening elevation of temperature and a rather rapid pulse (88–100). There was a good deal of cough with free expectoration of mucopurulent character. There was nothing noteworthy in the general examination except in the respiratory system. Dr. Cushing made a report on the lungs as follows: Chest shows retraction of left side, more marked in upper half (1 inch less at level of 3rd rib in front and ½ inch at level of 6th rib). Movements of the left chest slightly impaired. Heart normal in size and position, pulmonary second sound accentuated. Right lung practically normal. Left lung shows evidence of extensive fibrosis, especially marked over the upper lobe. Breath and voice sounds suggest a cavity in the front part of the upper lobe at the level of the 2nd rib in front, between the parasternal and midclavicular lines. Only occasional coarse râles heard in left lung. No fine crepitations. Sputum abundant, mucopurulent, and contains very numerous tubercle bacilli. Condition points to a chronic fibroid tuberculosis of left lung, affecting the upper lobe extensively and the lower to a less extent, with a moderate sized cavity in the upper lobe. The X-ray photograph confirmed this diagnosis. The cavity in the left apex was apparently about the size of a large plum, and lay under the second rib and the first interspace, a little outside the sternum.

In view of the impossibility of establishing a pneumothorax, and considering also the fact that the disease was confined almost entirely to one side, I judged the case to be particularly suitable for thoracoplasty. Accordingly, on December 4, 1917, I proceeded to do the first stage, following in the main Sauerbruch's technique. At this operation, under gas-oxygen, combined with local anaesthesia, through a vertical posterior incision, I removed portions of the 3rd to the 10th ribs, from 2 up to 4½ inches, leaving only the second and the first untouched. The parietal pleura was found moderately thickened throughout; and the lower lobe felt only slightly firm, while the upper lobe showed large patches of dense, hard infiltration.

The operation was completed in less than an hour and the patient stood it very well. Recovery was complicated by a flareup in the lung, beginning on the fifth day following operation, characterized by fever and increased sputum, and also a small haemorrhage, but he overcame this largely before discharge on January 20. Dr. Cushing at this time reported that the left side of the chest was markedly retracted and practically immobile. The heart apex was displaced to the left, about 1½ inches outside the nipple line. There was evidence of consolidation of practically the whole of the left lung with intense bronchial breathing and high-pitched crepitations in the left axilla. He was discharged on January 31, 1918, with a recommendation to return in a few months, in order to have his thoracoplasty completed by the resection of the uppermost ribs either behind or in front, inasmuch as it was considered that the present operation would not suffice to bring about compression of the upper third of the lung, and its contained cavity.

After returning home, the cough and profuse expectoration of his flareup shortly disappeared. He continued his cure and his general health improved until July, 1918. The effect of the operation was, in his opinion, quite good. As he expressed it his condition was the nearest thing to good health that he had ever felt in the whole course of his disease. His sputum decreased very greatly and its previous bad odor and taste disappeared. It got thinner also, like "white mucus," and his cough disappeared, except for a short period in the morning. He was quite without fever, even after moderate exercise; and he was able to take much more exercise than before.

In July, 1918, after a motor trip, during which he was greatly fatigued, he had a fever of 102°, with increase of sputum, all of which lasted a month. During the fall of 1918 he felt better than ever. In January, 1919, he had an attack of influenza, with a return of previous symptoms. He recovered and was well again for two months, when he had another attack of the same sort. In May he took to bed with pains in all his joints, so acute that he was quite crippled for ten days. During the fall of 1919 he was fairly well, but from the beginning of November he felt rather miserable and gradually lost strength, though not weight. Since before the operation he had had occasional diar-

rhoea without pain. The stools however, were never watery nor more than two a day. The diarrhoea alternated with constipation. It should be said that towards the end of 1918 the patient married. and is now the father of a healthy boy. In general, during 1919, he gradually lost much of the good effect of his operation. By the fall he was expectorating about two ounces a day of thick yellow purulent sputum, occasionally with a bad odor, he was suffering repeated attacks of fever with increase in cough and sputum, and he felt himself still an invalid, unable to take up any steady work, even of a light nature. He decided, therefore, to return for the completion of the operation, as had been advised. He was admitted to the Royal Victoria Hospital December 11, 1919, two years after his first stage.

On December 16, 1919, the operation was carried out as follows: The anaesthesia, gas-oxygen and local, was satisfactory. A flap of skin, fat and pectoral fascia, with base at shoulder was reflected. The pectoralis major muscle over the 2nd space was separated in the direction of its fibres; the lesser pectoral was freed and pulled outwards. Three inches of the 2nd rib were resected, including ½ inch of the costal cartilage. The pleura directly underneath was seen to rise and fall paradoxically with respiration. It was moderately thickened, and evidently overlay a big cavity, as it could be pushed in flat. The lung above felt hard and nodular. The parietal pleura was separated with the finger well up to the top, inwards to the sternoclavicular joint, and outwards to the shoulder and backwards to the posterior surface of the 1st rib, leaving a large open space. Two inches of the 3rd rib were then excised, and ½ inch of the 4th, about in the nipple line. The pleura was freed back over the 3rd rib, well to the side. As a result the upper lobe was thoroughly liberated over most of its upper and anterior surfaces, but not well down posteriorly. It was decided not to go further, on account of the possible danger of rupturing the lung by working blindly at the back. One also did not wish to prolong the operation unduly. This could be done later, if necessary, from the back. The whole central portion of the great pectoral was then isolated by blunt separation of its fibres close to the clavicle, leaving the clavicular portion; and, by a similar separation, as low as the level of the 3rd rib. This portion was cut off about 1 inch from the humeral attachment, and was loosened from its lower rib insertions, the pedicle being at the sternal edge, so that it could be curled up and stuffed into the upper space left by the separation of the parietal pleura. It filled it very well. The 1st rib was not cut, thus leaving a brace for the muscle plug. The lesser pectoral was then separated from its rib attachments down to the fourth space, leaving a bulky free end which was packed into the separated area underlying the 2nd space and the 3rd rib. About eight catgut sutures were used to tack the muscle down to the remains of the intercostals and rib periosteum. The ultimate compression obtained seemed to be good. The skin flap was sutured without drains. (See figs. 1 to 5.)

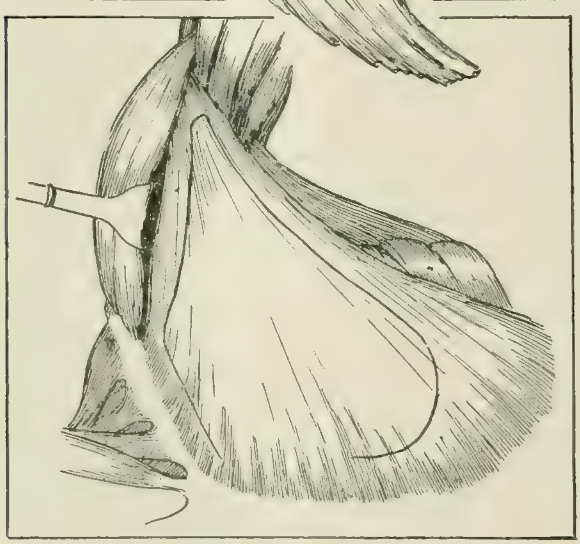

Fig. 1. Showing Skin Incision and Cutaneous Flap and Lines of Incision in Pectoralis Major Muscle

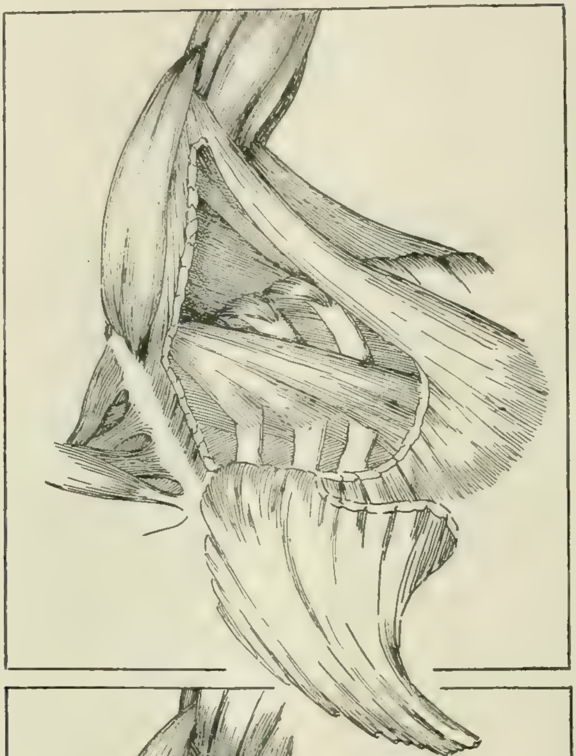

Fig. 2. Showing Muscle Flap Dissected out of Pectoralis Major and Reflected

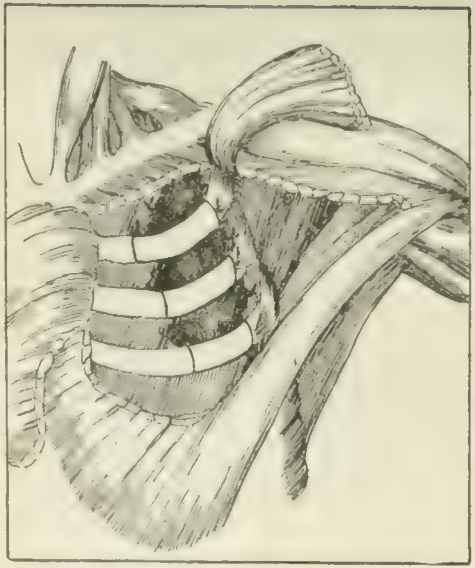

FIG. 3. SHOWING FLAP OF PECTORALIS MINOR REFLECTED

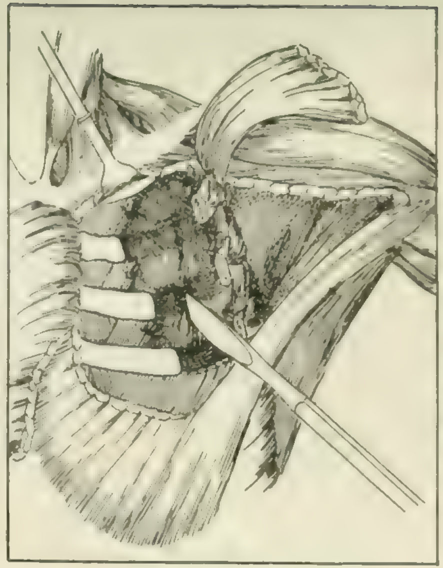

FIG. 4. SHOWING SUBPERIOSTEAL RESECTION OF 2ND, 3RD AND 4TH RIBS, AND LINES OF INCISION IN PERIOSTEUM COVERING POSTERIOR SURFACE OF RIBS

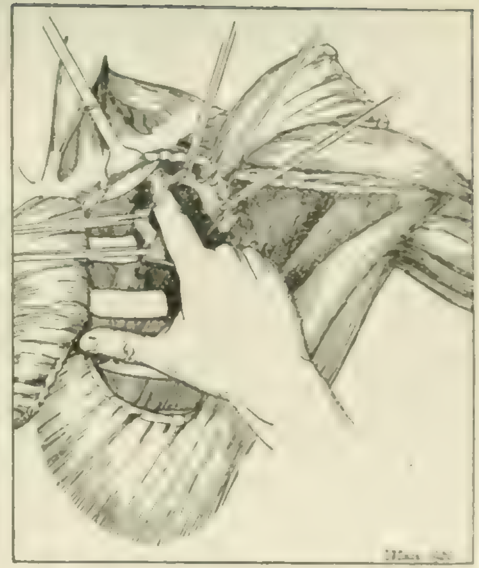

FIG. 5. SHOWING BEGINNING OF SEPARATION OF THE UPPER LOBE OF LUNG OUTSIDE THE PARIETAL PLEURA

The postoperative course can be resumed briefly. The patient had surprisingly little distress on the whole, and needed no sedative whatever for cough; in fact, from the time of operation on, his cough was practically abolished, and likewise his sputum. On January 8, 1920, I made the following note: Before operation the sputum was about two ounces a day, and was thick, yellow, and purulent, with occasional bad odor. This amount was got up chiefly in the forenoon, though coughing was not difficult. In the evening he also brought up a small amount. After operation there was no cough whatever for a few days, after which it was very slight,—"just a little hawk." As to the sputum there was none for three days, then there appeared gradually a small amount, which, however, had become white, clear, mucoid, and somewhat frothy. The amount was not over half an ounce. It seemed to be largely saliva, with mucoid phlegm. His temperature did not go above 99.6° and that only during the first two days. His pulse, however, registered 120 to 130 during those two days. After that it ran between 80 and 90 for a week, following which it came down to between 70 and 80. Respirations were very little increased: before operation they ran 18 to 22; after operation 20 to 24, finally coming back to normal in the course of ten days. Sputum was bloodtinged on the day following operation, but not afterwards. The wound healed perfectly, and he was discharged January 11, feeling very well.

An X-ray photograph, taken just before he left the hospital, showed the abscess compressed apparently to a mere slit. A report received from Dr. Parfitt of his examination of this patient on April 1, 1920, that is about three months after his operation, I may here reproduce briefly: Patient looks surprisingly well; has a good color; coughs very seldom, usually after slight exertion. Expectoration greenish, about one-half ounce daily; bacilli negative. No dyspnoea ordinarily; not very marked on slight exertion. No pain. Arm movements only slightly limited; can reach opposite shoulder and can feed himself. Chest measurements: expiration 33 inches; inspiration $33\frac{7}{8}$ inches. Right side, expiration 18 inches, inspiration 19 inches; left side, expiration $15\frac{1}{2}$ inches, inspiration $15\frac{7}{8}$ inches. In the erect position the right side is enlarged and rounded; the movement apparently excessive; the movement of the left side almost nil. Under the left clavicle in the region of the resected ribs there is a marked depression and on inspiration a deep indrawing. The right lung is hyperresonant and shows complementary hypertrophy extending beyond the sternum. The breath sounds in the left interscapular region are variable in quality and are probably transmitted from the opposite side. Râles here are also probably transmitted. Above the second rib there is slight vesiculo-bronchial breathing and a few crepitations. Over the left lung dulness is marked throughout. There are variable amphoric and bronchial breath sounds throughout. Râles of variable size are relatively few.

Case 2. Miss L. H., age twenty-four years. Admitted February 12, 1920. The patient was always in perfect health up to the spring of 1917, when she had an attack of tonsillitis. Ten days later she developed measles. She recovered fully and returned to duty (nursing) but suffered from easy fatigue. She continued work until July 1, 1917, when the tonsils were removed. Convalescence was slow. About the end of July she began to cough and expectorate. In September the sputum increased in quantity up to two ounces in twenty-four hours, in which bacilli were found. In September, 1917, she went to Saranac Lake, where she spent the next two winters, returning home in summer, but not following a rigid cure. Her cough and expectoration persisted while at Saranac Lake. She went to Dr. Parfitt, at Gravenhurst, in October, 1919. After three weeks a leftsided pneumothorax was established. The patient did not find any marked change as the result of the pneumothorax, in regard to sputum and cough. Her general condition has always been good throughout her illness. The elevation of temperature was never at any time a constant factor. After five refills of her pneumothorax she was told that she had fluid at the base of the left lung (6 or 7 ounces).

The X-ray picture at Gravenhurst showed a good collapse of the lower two-thirds of the lung, while the apex remained unaffected on account of adhesions. In this upper third of the lung there were observed several small cavities with surrounding infiltration. In view of this condition Dr. Parfitt advised her to have a thoracoplasty done. She came to Montreal on February 12, 1920. Her condition upon admission may be briefly resumed. Patient is well nourished. She has frequent cough and expectoration amounting to about two ounces in the twenty-four hours. The sputum is mucopurulent and is brought up chiefly in the morning. It contains numerous tubercle bacilli. On the right side, that is, the good side, the lung shows slight scattered infiltration in the lower lobe, to which correspond, on physical examination, a few fine crepitations at the base posteriorly. In the X-ray there were also a few suspicous spots in the apex. On the left side the percussion note was dull over the apex down to the level of the base of the heart, and her breath sounds were greatly diminished, with numerous fine moist râles accompanied by musical râles on deep inspiration. Similar signs were present posteriorly. Below this level there were signs pointing to fluid, the level of which reached nearly to the angle of the scapula. The amount of air in the chest was still sufficient, with the fluid, to give a good collapse of the lower two-thirds of the lung.

It was obvious that one had to choose between opening the pleura below, and cutting all adhesions so as to complete the pneumothorax, or, on the other hand, doing an apicolysis outside the parietal pleura and implanting muscle as in the previous case. The first procedure is one which should hardly be done unless the adhesions are confined to isolated points. This has been

done by Jacobaeus through the thoracoscope and with a cautery, and also by the writer in one instance through open incision. The objection, however, lies in the fact that occasionally a cavity in the lung substance extends a little distance into the base of the adhesion, and such a cavity has been opened during the cutting of the adhesions with resulting pyopneumothorax. This appears to have happened in a case reported by Torek, of New York. In any case where adhesions are dense and occupy a good portion of the upper surface the danger of tearing into the lung is much too great. The extra-pleural method is by all odds the safer and in the present instance it was decided to do, first, an apicolysis from the front, and later, to do a thoracoplasty behind over the upper seven ribs, leaving the lower part of the lung for continued compression by the artificial pneumothorax.

Accordingly, on February 19, 1920, the first operation was performed. The anaesthesia was gas-oxygen, with novocaine, and was quite satsfactory. The operation was similar to that already described, with the exception that a straight transverse incision, from the edge of the sternum to the anterior edge of the deltoid over the middle of the pectoralis major, was employed, instead of a flap incision. This gave quite sufficient exposure, and left a smaller scar. The muscle flaps from the two pectoralis muscles were prepared before the ribs were resected. The 2nd, 3rd and 4th ribs were excised in lengths, respectively, of $2\frac{1}{2}$, $2\frac{3}{4}$, and $2\frac{1}{4}$ inches, subperiosteally. The intercostal musc'es in the 2nd and 3rd spaces were removed. The posterior layer of periosteum of the 2nd and 3rd ribs was incised, lifted off the pleura, and packed away so as to permit separation of the parietal pleura. The apex of the lung was separated with the finger from under the clavicle and the 1st rib, and from side to side, but not more than an inch or so downwards at the back. It felt hard, nodular and diffusely infiltrated; but the lung, from the upper edge of the 2nd rib down to about the upper edge of the 4th rib, felt soft and ballooned slightly on inspiration, collapsing slightly on expiration. The pleura was separated anteriorly well in to the edge of the sternum and well out to its external aspect about the anterior axillary line and down as far as the 4th space. This left a big pocket in front, at the apex and at the side, into which the flap of great pectoralis was crowded. This was big enough to fill the space comfortably. Its lower edge was held in place by no. 2 chromic gut doubled, passing through a drill hole in the stump of the 4th rib. Its upper third, or nearly half, filled up the cavity left at the apex. This was held there by a similar stitch through a drill hole in the 2nd rib, attached to the anterior part of the muscle well over towards the sternal border so as to prevent retraction.

The clavicle and the 1st rib afforded a brace for the muscle pad and the same is true of the stumps of the 2nd, 3rd, and 4th ribs for the lower part of the muscle pad. Another stitch held the muscle to the stump of the inter-

costal muscle and the periosteum of the 3rd rib. Between this last stitch and the 2nd rib stitch, the flap of the pectoralis minor could be shoved without trouble, thus forming an extra amount of compression over the region under which the bulk of the lung cavity was situated. This was held in place by further chromic sutures uniting it to the anterior surface of the great pectoralis pad. It could be seen during an occasional slight coughing of the patient how the expiratory forcing up of the lung compressed the lung itself against the muscle pad inserted under the stumps of resected ribs, so that it would seem advisable not to resect too great a length of ribs on the side. The lung felt hard towards the lower axilla and outside the upper part of the heart under the stumps of the 3rd and 4th ribs.

The operation was borne very well. It is true that the patient complained of a good deal of pain, also of shortness of breath, and her pulse ran up to somewhat over 100, but there was very little fever, and it was obvious that there was no particular reaction on the part of her lungs. Sputum was much diminished; on the third day it was pinkish and remained so for a couple of days, after which it became as before. Her cough was sufficiently controlled with heroine. Ten days after operation sputum, as measured, was one ounce in twenty-four hours, and mucopurulent.

On March 5, 205 cc. of pale strawcolored fluid was removed from the chest, and 900 cc. of nitrogen introduced. Upon examination of the fluid no tubercle bacilli were found. Albumen was 14 gms. per litre.

On March 9, the posterior operation was done through a vertical incision. From one to three inches of the 2nd to the 7th ribs inclusive were removed. The apicolysis begun in front at the previous operation was now completed from behind, creating a large cavity from the apex right down to the 5th rib and over to the vertebral column and well over under the scapula. It was necessary, however, to leave a firm adhesion, situated about over the upper outer corner of the apex under the stump of the 2nd rib, as it felt at that point that one might break into tuberculous tissue. The scapula with its attached muscles, that is, their cut edges, was pushed under the stumps of the resected ribs, posteriorly, towards the middle line, and held there as far as was possible by suturing the other cut edges to the deep fascia, so as to hold the scapula down as much as possible.

This operation was also perfectly well borne, although the pain suffered was rather greater than at the previous operation. Dyspnoea was considerable. There was, however, no rise of temperature worth while, and the pulse, although fast, was at no time such as to cause any alarm. The sputum was pinkish for four or five days, after which it remained clear. On March 20, the patient was allowed out of bed, and could move about the room freely, although there was some dyspnoea. The amount of sputum at this time was one-half ounce in twenty-four hours. The patient had no pain. The left

side of the chest showed definite falling in, anteriorly, under the clavicle. There was practically no drooping of the shoulder or interference with the function of the pectoral muscles. The patient could place her arm to the head with very little difficulty or exertion. An examination of the sputum showed that the bacilli had disappeared. She was allowed to go home on April 2. At this time our notes record that the cough was very slight, was chiefly in the morning and was apparently more of a hawk than a cough. The amount of sputum had diminished to from two to four drams in the twenty-four hours. She was gradually improving in strength, and her dyspnoea had lessened very markedly. On April 11, Dr. Parfitt sent me a memorandum concerning her condition as he found it on that date. This I here copy:

> The patient appears in excellent general condition. She stands very erect and there is nothing noteworthy about her in ordinary garb. There is surprisingly good movement of the arm, with easy abduction to the level of the shoulder. The left side is distinctly smaller and is motionless. The left breast bulges rather more than the right because of the contraction of the left side. There is indrawing in the axilla and in the scapular region when the patient stands erect. There is no movement on respiration. Although the second operation was done less than six weeks ago, there is no pain except slight tenderness of the third interspace near the sternum.
>
> Measurements are as follows: chest depth, at level of 8th spine and 5th cartilage, $6\frac{5}{8}$ inches; breadth, $9\frac{1}{4}$ inches; length, $10\frac{1}{2}$ inches; right oblique, $7\frac{1}{2}$ inches; left oblique, $8\frac{1}{4}$ inches; circumference, expiration 31 inches; inspiration, $31\frac{1}{2}$ inches; right side, expiration, $15\frac{3}{4}$ inches; inspiration, $16\frac{1}{4}$ inches; left side, expiration, $15\frac{1}{2}$ inches, inspiration, $15\frac{1}{2}$ inches. This discrepancy in size of left side must, I think, be accounted for by the bulging of breast and the incurving of axilla not being allowed for probably by the tape.
>
> On auscultation, the left side shows extreme feebleness of breath sounds, of slight bronchovesicular quality in the upper part of the chest, and almost complete absence in the lower. I heard no râles in this side at the only examination that I have made. The right side shows bronchovesicular breathing at the apex and in the interscapular region, with crepitations.
>
> The patient has almost no cough, and the sputum has been reduced to about two drams daily. Before the first operation there was from one to one and three-quarter ounces daily. After the first operation it decreased to six drams and has steadily dropped since the second operation, and is now mucoid in character. The temperature ranges from 97.2° to 98.8°. Pulse varies between 88 and 100. Dyspnoea is quite marked on slight exertion.
>
> A small pneumothorax was given on April 9th. The initial reading was + 15 + 35 mm. After 100 cc. the reading was + 30 + 40 mm.

X-ray photographs show very marked retraction of the left side and practically obliteration of the area in the upper lobe in which there had been originally visible, to use Dr. Parfitt's expression, a catacomb of cavities.

It is of course obvious that as yet no definite claims can be made in favor of the modification of the operation of apicolysis here described, but it has seemed worth while to publish the method in order that it might be tried upon suitable cases by other surgeons. In selected cases the operation is not at all formidable, healing is rapid, and the resulting

deformity slight. The indications for the operation should be drawn somewhat closer than for artificial pneumothorax. The best cases are those of chronic disease with marked tendency to fibrosis with cavity in the upper lobe and strictly, or almost strictly, unilateral.

LITERATURE CITED

TUFFIER: Interstate Med. Jour., 1914, xxi, 259.
SAUERBRUCH: Münch. med. Wchnschr., September 2, 1913, 1944.
FRIEDRICH: Münch. med. Wchnschr., 1911, nos. 39 and 40, and Med. Klin., 1912, no. 15.
SAUERBRUCH AND ELVING: Ergeb. d. Med. und Kinderheilk., 1913, x.

Postscript. December 13, 1920: A recent letter from the first patient gives the following summary of his condition in December, 1920, as compared with December, 1917, before the first operation. Temperature averaging 99.3 to 100 (oral) is now 98 to 99 (rectal). Pulse 88 to 110 is now 68. Sputum 4 to 6 ounces or even 8 ounces daily is now 1 to 2 ounces daily. Weight 132 pounds is now 155 to 160. He says, "I feel very well, in fact better than I have ever been since I took down with tuberculosis in the spring of 1912." Sputum last July contained no tubercle bacilli. He is now able to do light work as a canvasser from four to six hours a day and occasionally all day. Cough is very slight.

The report on the second patient is not quite so favorable. Three months after operation there occurred a mild flare-up in the sound lung. This was overcome during the summer, but there are signs in the X-ray of a small cavity at the apex, on the good side. Sputum is down to half an ounce in a day. Subjectively she feels better now than at any time. The left side, that of operation, is fairly motionless, but the screen still shows two or three small cavities not completely compressed. It is a question whether the lower half of the chest, previously filled with air and fluid, should not have been collapsed by operation. There still remains a little fluid but it is doubtful if the lower lobe is sufficiently compressed by it.

THE PURINE BASES OF THE TUBERCLE BACILLUS

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In the course of an investigation on the nutrition of the tubercle bacillus involving a study of the synthesis of the nitrogenous compounds peculiar to nucleoproteins, namely the purine and pyrimidine bases, it has become necessary to determine the identity and amount of such substances in bacilli grown upon ordinary glycerol broth and also upon media of known chemical composition. It has generally been taken for granted that nucleic acid, and therefore the peculiar bases entering into its composition, makes up an unusually large share of the protoplasm of bacteria as compared with other forms of life. If this is so then in organisms grown upon media containing nitrogen only in the form of ammonia or amino acids there must be a synthesis of these bases on a large scale.

Pyrimidine bases were early identified in the bodies of tubercle bacilli by Kitajima (1) and by Levene (2). Thymine was the first encountered and for a long time was thought to be an important constituent of a nucleic acid characteristic of the tubercle bacillus.[2] Cytosine was also found and Levene obtained some evidence for the presence of uracil. Accurate quantitative estimations of the purine bases in the substance of the tubercle bacillus are not on record, although Ruppel (3), and others have identified guanine, xanthine, and adenine in its decomposition products.

[1] Fellow of the Trudeau Foundation.

[2] It is now generally believed that there are but two nucleic acids, an animal form containing phosphoric acid in combination with a hexose and the purine bases guanine and adenine, and the pyrimidine bases cytosine and thymine, and a plant form containing phosphoric acid with a pentose, the purines guanine and adenine, and the pyrimidines cytosine and uracil. The abundance of proof for this assumption casts doubt on the identity of the highly toxic "tuberculinic acid" of Ruppel (3), which probably owed its poisonous character to specific protein combined with it. Nucleic acids are neither toxic nor specific. Thymine being present in the tubercle bacillus one would also expect to find that the sugar of the nucleic acid is a hexose, pentose being found characteristically in the plant form in association with uracil. Experiments to determine this are projected.

Hydrolyses were made of 100 gms. of anhydrous human type tubercle bacilli (H37), which had been repeatedly washed with water and desiccated in vacuo over sulphuric acid, and of 3.09 gm. of anhydrous bacilli (also H37) grown in 80 bottles on a medium of the following composition:

NH_4Cl	M/10, sole source of N
Glycerol	4 per cent, sole source of C
Na_2HPO_4	M/150
KH_2PO_4	M/150
NaCl	0.3 per cent
$MgSO_4$	trace
pH	6.8

The purines were isolated by the Kruger-Solomon method. The following table gives the results of analyses:

	GUANINE	IDENTIFICATION	ADENINE	IDENTIFICATION*	LIPOIDS†
Broth bacilli, 100 grams	0.213 gram 0.21 per cent	Characteristic crystals of guanine hydrochloride. Strong nitric acid reaction	0.2 gram 0.2 per cent	Melting point of picrate. 277°	21.8 per cent
NH_4Cl-glycerol bacilli, 3.09 grams	0.012 gram 0.39 per cent	Characteristic crystals of guanine hydrochloride. Strong nitric acid reaction	0.009 gram 0.30 per cent	Melting point of picrate, 283°	27.2 per cent

* Adenine picrate when pure melts with some decomposition at 280°.

† Benzene soluble. The broth grown bacilli were hydrolyzed before the removal of lipoids. The latter, recovered later with benzene, thus consisted of fatty acids and waxes only, while the lipoids of the bacilli of the synthetic medium, which were extracted before the hydrolysis, included these and also the glycerol of neutral fats, and the phosphorus and nitrogen containing substances of the phosphatids. Hence the higher figure.

The combined purines thus represented 0.41 per cent of the dry weight of the broth grown bacilli and 0.69 per cent of the NH_4Cl-glycerol bacilli. As nucleic acid, according to the recently developed formula of Levene and Jacobs (4), contains approximately one-fifth of its weight as purine bases, the nucleic acid may be calculated as about 2 per cent of the dry weight of the broth bacilli and 3.5 per cent of that of the others. These are relatively smaller amounts than would be expected in view of the common assumption of a high nucleic acid content of the

bacillus, even when it is conceded that the Kruger-Solomon method is not strictly quantitative.

It is a noteworthy fact that xanthine was not found among the purines, and that while after the isolation of guanine and adenine a small amount of substance remained precipitable by copper sulphate and sodium bisulphite, the latter could not be made to yield characteristic crystals of either hypoxanthine nitrate or hypoxanthine silver nitrate, so that hypoxanthine too may be assumed to be absent. As xanthine and hypoxanthine are recognized as the decomposition products of guanine and adenine respectively, resulting from enzymic deaminization, it may be inferred from their absence that autolysis is not a prominent feature in the history of a culture of the tubercle bacillus, and that the purine bases which are present are simply those of the intact nucleic acid molecule. This is in accord with the well known fact that fresh tubercle bacilli suspended in sterile water and incubated do not autolyze with the production of more than traces of ammonia or other soluble nitrogen.[3] This inability to autolyze has been attributed to the presence of inhibitory agents in the form of unsaturated lipoids (5). It should be added that the addition of copper sulphate and sodium bisulphite to the hot concentrated filtrate from the NH_4Cl-glycerol bacilli failed to show the presence of any purines whatsoever, nor did picric acid give a precipitate.

The material used in this investigation afforded an opportunity for certain other observations, which may be reported briefly. The bacillary substance of the NH_4Cl-glycerol bacilli readily gave the color tests for tyrosine and tryptophane, thus proving the synthesis of these complex substances, as well as the purine bases, from the simple nitrogen and carbon compounds of the medium. Logie (6), who found that tryptophane was synthesized by B. coli and B. Friedländer in protein-free media, containing N in the form of ammonium salts and asparagin, believes that synthesis of such ring compounds supports the view of the vegetable nature of bacteria. The filtrate from these organisms was, on concentration, a potent tuberculin, two tuberculous guinea pigs reacting strongly to a skin test of 0.1 cc. of the four times concentrated Berkefeld filtrate, to which control animals did not respond. This tuberculin did *not*, however, give the biuret test or any of the other protein

[3] In unpublished observations I found that only 5 mg. of nitrogen were liberated in two weeks autolysis of 5 grams of tubercle bacilli killed by toluene.

tests except the recently reported ethyl acetate test of Marie (7), the status of which is yet to be decided.

In some experiments on the extraction of the nucleoprotein it was found that the protein extracted from intact tubercle bacilli by the method used by Krakow (8) and Iwanoff (9) in the preparation of bacterial nucleoproteins, namely, treatment of the bacterial substance with copper acetate and repeated extraction of the mass with dilute sodium hydrate until fading of the biuret reaction, followed by precipitation of the extract with acetic acid, is not a nucleoprotein at all, phosphorus and purine bases being entirely absent. This substance was apparently the extrabacillary substance present in cultures, the excretion product described as lying between the bacilli, stains of the residue showing normal appearing acid-fast bacilli. Twelve grams of this protein were readily obtained from 100 grams of dry tubercle bacilli and used for certain immunological experiments after being thoroughly washed with water, alcohol and ether and passed through a Berkefeld filter in faintly alkaline solution. Repeated solution in weak alkali and reprecipitation with acetic acid did not free it from copper, which remained present in a concentration of approximately 1 per cent. The following results were obtained with this material:

Two tuberculous guinea pigs reacted positively to a skin test with 0.001 gram while normal guinea pigs did not.

Two tuberculous guinea pigs, infected two months previously with pleural fluid containing many tubercle bacilli, died twelve hours after injection with 0.025 gram. The autopsy disclosed acute lesions in lungs, liver and spleen, with marked congestion around them, the latter presumably the result of the reaction. Two normal guinea pigs were not affected by injection of the same amount, even the temperature remaining constant. One guinea pig, infected a year and a half previously with R1, a human strain of low virulence, died six days after the injection of 0.025 gram, whether as a result of the injection or not it could not be determined. On autopsy small chronic, fibrous lesions were found in the inguinal lymph nodes and spleen. Another pig, similarly infected, died six hours after an intravenous injection of 0.01 gram. At autopsy unusually acute lesions for an R1 infection were found.

Five normal guinea pigs, sensitized with 0.001 gram reacted to second injections of 0.005–0.025 gram twenty days later with sickness and a drop in temperature of 2 to 5 degrees persisting for at least three hours. One of these died within twelve hours, that receiving 0.008 gram, death

not being accompanied by the bronchial changes of typical anaphylactic shock. Two tuberculous pigs showed a rise in temperature of 1.7° each, three hours after a similar injection. One died twelve hours later, the autopsy disclosing caseous tuberculosis of liver and spleen, with marked congestion in the neighborhood of tuberculous areas.

From these experiments it may be concluded that tuberculous guinea pigs were specifically sensitive to the protein thus obtained, which was nontoxic for normal animals. The allergic reaction, however, developing in guinea pigs on second injection twenty days after sensitization with 0.001 gram of the material, was rather mild.

SUMMARY OF CHEMICAL RESULTS

The purine bases, guanine and adenine, were isolated in pure form from two groups of tubercle bacilli, one grown on glycerol broth, the other on a simple medium containing NH_4Cl as the sole source of nitrogen. The amounts isolated were respectively 0.4 per cent and 0.7 per cent of the dry weight of the organisms, from which it may be calculated that the nucleic acid content is between 2 per cent and 3.5 per cent, using the Levene and Jacobs formula, and assuming that the Kruger-Solomon method of purine isolation is approximately quantitative. Xanthine and hypoxanthine were absent, a fact which indicates that little autolysis had occurred during the two months of growth of the cultures, the purines present being those of the intact nucleic acid molecule. No purines were detected in the filtrate from the bacteria. The amino acids, tyrosine and tryptophane, were readily identified in the bacteria grown on NH_4Cl and glycerol. The total benzene soluble material was 27.2 per cent. The filtrate from these bacteria was a potent tuberculin, but failed to show the presence of dissolved protein by any of the characteristic color tests.

REFERENCES

(1) Kitajima: Cited in Centr. f. Bakt. u. Parasit., Ref., 1903, xxxiii, 727.
(2) Levene: J. Med. Res., 1904, xii, 251.
(3) Ruppel: Zeit. physiol. Chem., 1898, xxvi, 218.
(4) Levene and Jacobs: J. Biol. Chem., 1912, xii, 411.
(5) Jobling and Petersen: J. Exp. Med., 1914, xix, 239.
(6) Logie: J. Path. and Bact., 1920, xxiii, 224.
(7) Marie: Ann. l'Inst. Pasteur, 1920, xxxiv, 159.
(8) Krakow: Wratsch, 1901, cited by Iwanoff.
(9) Iwanoff: Hofmeister's Beitr., 1902, i, 524.

THE MECHANISM OF THE BACILLUS CARRIER STATE

WITH SPECIAL REFERENCE TO THE FRIEDLÄNDER BACILLUS

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During the course of experiments on the fate of bacteria introduced into the upper air passages, we became interested in the question of the mouth as an environment for bacterial growth (1). The rapid disappearance of foreign organisms after experimental introduction suggested that the free surface of the buccal mucous membranes, when intact, were unfavorable for the colonization and growth of extraneous bacteria. As a corollary of this conclusion the question arose whether in the so called carrier state the organisms are confined solely to some focus of acute or chronic diseased tissue whence they are discharged to the free surfaces of the mouth and throat, or whether the organisms actually live on and grow diffusely over these surfaces.

We have found no experimental evidence bearing on this point, but clinical observations suggest the great importance of a focus of infection in the mechanism of the carrier state. A brief review of these facts may be presented before detailing our experimental observations.

CLINICAL OBSERVATIONS ON THE LOCALIZATION OF BACTERIA IN CHRONIC CARRIERS

In the present discussion we shall consider only so called chronic carriers. By this term we mean individuals who harbor, more or less constantly, in the upper air passages, some pathogenic organism, either following disease, or without any history of previous disease due to the organism in question. A few of the main types of such carriers may be mentioned to illustrate the principles involved.

1. Diphtheria carriers. The persistence of positive cultures in many instances following diphtheria is a matter of common experience. Often the organisms are present for indefinitely long periods— months or even years. In such cases they not uncommonly disappear following tonsil-

lectomy, when all other measures had previously been unavailing. The fact that cultures made from the depths of the crypts or from beneath the capsule of the excised tonsils show numerous diphtheria bacilli suggests that these glands may be the breeding places of the organisms, and that the latter were not growing and multiplying on the free surfaces of the normal mucous membranes.

2. Streptococcus. The presence of virulent hemolytic streptococci in the throats of healthy people has been frequently noted, especially at times when streptococcus disease is prevalent. While the organisms may occasionally be obtained from the throat or nose, it is found in general that a much higher percentage of positive yields results if cultures are made from tonsil crypts. Thus, Pitot and Davis (2) found hemolytic streptococci in almost 100 per cent of excised tonsils. Furthermore, it appears that in streptococcus carriers tonsillectomy is often followed by the disappearance of the organisms from the throat (Tongs (3), Van Dyke (4)). These observations suggest that here again the tonsil is often the breeding place of the streptococcus, whence the germ is discharged to the free surfaces of the throat without actually colonizing there.

3. Meningococcus. In a variable number of normal individuals meningococci are found on repeated cultures. Studies such as those of Herrold (5) show that a much larger percentage of positive cultures can be obtained from the nasopharynx than from the tonsils, nares, or sputum. Furthermore, the application of disinfectants directly to the nasopharynx seems to lead to the clearing up of carriers more promptly than treatment of other parts of the upper air passages.

In summary, then, the weight of clinical evidence in the case of carriers of important pathogens tends to show that the organisms actually colonize in a focus of diseased tissue in the upper air passages whence they are discharged to the free surfaces. It seems probable that bacteria do not actually localize and grow upon the latter, but that they are constantly washed away only to be replaced by other organisms freshly discharged from the focus. We have been unable, however, to find any actual experimental proof or disproof of this idea.

In the course of some studies of Friedländer bacillus carriers, methods by which this point might be demonstrated suggested themselves, and the present paper deals with these observations. They are based mainly on an intensive study of three carriers whose histories are appended in some detail.

Case 1. G., aet. 50, colored, male. Diagnosis: Syphilis, aneurysm of aortic arch, aortic insufficiency, myocardial insufficiency. History: No history of severe colds, of sinus infection, tonsillitis, cough or pneumonia. Examination: Nose: Negative except for racial hypertrophy of turbinates. Tonsils: Moderately enlarged and injected. Pharynx: Negative. Larynx: Negative. Ears: Negative.

Case 2. W. J., aet. 31, male, colored. Diagnosis: Acute nephritis. History: Frequent colds but no sore throats or tonsillitis. No pneumonia. No cold "this year." Examination: Nose: Anterior ends of middle turbinates look normal. There is no discharge. Tonsils: Embedded. There are numerous plugged crypts on each side. Pharynx: Negative. Nasopharynx: A moderate amount of adenoid tissue is seen. Ears: Drums intact, no retraction. Sinuses: Clear on transillumination.

Case 3. J. H., aet. 34, white. Diagnosis: Chronic rheumatic endocarditis, aortic and mitral insufficiency. History: No history of severe colds, sore throats, sinus infections, or pneumonia. Examination: Nose: Septum deflected to right, causing partial nasal obstruction. Small amount of discharge on both sides. Pharynx: Clear. Ears: Marked grade of retraction of drums on both sides. Tonsils: Moderately enlarged and adherent. Nasopharynx: Polypoid inferior turbinate posteriorly on right. Eustachian orifices clear. No discharge from posterior sinus orifices.

INCIDENCE OF FRIEDLÄNDER BACILLUS CARRIERS

Eighty-five unselected individuals were examined. Friedländer bacilli were isolated from the throats of five, a percentage of 5.8.

PERSISTENCE OF FRIEDLÄNDER BACILLI IN CARRIERS

In every instance the carrier state persisted during the entire period of observation (table 1). We have no idea of its previous or subsequent history.

TABLE 1

Persistence of Friedländer bacilli in carriers

NAME	PERIOD OF OBSERVATION	NUMBER OF CULTURES	NUMBER POSITIVE	NUMBER NEGATIVE	LAST CULTURE
G.	42 days	16	16	0	Positive
J.	36 days	12	12	0	Positive
W.	4 months	15	13	2	Positive
H.	3 months	16	14	2	Positive

SPREAD OF FRIEDLÄNDER BACILLI FROM CARRIER TO CONTACTS

It seemed of interest to determine whether there was any tendency for contacts to acquire the organisms from the carriers and possibly to develop a carrier state themselves. Patient W. was in the ward for several months. During this period 285 throat cultures were made on 31 other patients in more or less close contact with him. In no instance were Friedländer bacilli recovered. Subsequently more careful contact observations were made on two other patients. The carrier and the contact were placed in adjacent beds. No attempt at isolation was

TABLE 2

Summary of cultures from Friedländer bacillus carriers and from contacts

CULTURE ON	BED 1 CARRIER G. FEB. 17	BED 2 CARRIER J. MARCH 20	BED 3 CONTACT T. MARCH 20
March 23	+	+	0
March 24	+	+	0
March 25	+	+	0
March 27	+	+	0
March 29	+	+	0
March 30	+	+	0
		CONTACT T. MARCH 30	
March 31	+	0	
April 1	+	0	
April 3	+	0	
April 5	+	0	
		CONTACT W. APRIL 6	
April 7	+	0	
April 8	+	0	
April 9	+	0	
April 12	+	0	
	CARRIER J. APRIL 1	CONTACT C. APRIL 5	
April 6	+	0	
April 7	+	0	
April 8	+	0	
April 9	+	0	
April 10	+	0	
April 11	+	0	
April 12	+	0	

made, and they used the same bed table and to some extent the same utensils. Cultures were made daily from the throats of contact and carrier (see table 2). At no time were Friedländer bacilli recovered from the contacts in spite of their persistence in the carrier. These observations agree with our experiments on the rapid disappearance of these organisms when experimentally introduced into the mouth in large number, and are an interesting contrast to the rapid spread of an organism which is producing disease such as occurs, for example, in epidemics of streptococcus infection.

SITE OF LOCALIZATION OF THE FRIEDLÄNDER BACILLI IN CARRIERS

Cultures were made from various parts of the upper air passages to determine the relative number of organisms present. As appears in table 3, while the organisms were constantly found in the pharynx in

TABLE 3

Results of cultures made from various parts of the upper air passages in Friedländer bacillus carriers

CASE	DATE OF CULTURE	NARES, RIGHT	NARES, LEFT	THROAT	RIGHT TONSIL	LEFT TONSIL	PHARYNX
G	March 27	No F	No F	13 cols. F	–	–	–
	March 29	No F	No F	∞ F	–	–	–
	April 4	2 cols. F	No F	∞ F	–	–	–
	April 5	No F	1 col. F	∞ F	–	–	–
	April 6*	No F	No F	–	100 cols. F	No F	No F
	April 8*	No F	No F	–	∞ F	No F	No F
J	March 27	No F	∞ F	∞ F	–	–	–
	March 29	No F	No F	∞ F	–	–	–
	March 31	No F	No F	∞ F	–	–	–
	April 8*	No F	No F	–	3 cols. F	13 cols. F	4 cols. F
	April 9*	No F	No F	–	∞ F	6 cols. F	22 cols. F
	April 11*	5 cols. F	No F	–	∞ F	No F	4 cols. F

* Throat thoroughly gargled with water before cultures were made.

large numbers, a few were occasionally recovered from the nares as well. The sequence of cultures seems to show that such organisms are introduced accidentally from the pharynx, and are promptly washed away without localizing on the nasal mucosa. Further differential cultures in two cases also showed that the organisms were constantly present on one tonsil. The tonsil, therefore, seemed to be the focus from which the bacteria were disseminated through the buccal cavity.

REIMPLANTATION OF CARRIER'S STRAIN ON HIS OWN MUCOUS MEMBRANES

With the above observations in mind, it seemed of interest to reintroduce the carrier's own strain upon his own mucous membranes. It seemed that this might give information as to whether these surfaces behave like those of normal individuals in whom the organisms introduced are promptly washed away; or whether, in the carrier, the organisms have adapted themselves to a free growth on the open surfaces of the upper air passages. It appeared (table 4) that organisms introduced in this way did not persist, but disappeared at the same rate of speed as Friedländer bacilli placed on the nasal septum of a noncarrier.

TABLE 4

Introduction of carrier's own strain upon his own mucous membranes

NAME	DATE	CULTURE RIGHT NOSE	CULTURE LEFT NOSE
G	April 4	2 cols. F.	No F.
1 Loop of solid growth B. Friedländer—strain G, inoculated on left nasal septum			
G	Cult. immediately	No F.	∞ F.
	Cult. after 1 hr.	No. F	∞ F.
	Cult. after 24 hrs.	No F.	No F.
	Cult. after 48 hrs.	No F.	No F.
	March 29	No F.	No F.
1 Loop of solid growth B. Friedländer—strain J1, inoculated on right nasal septum			
J	Cult. immediately	F.	No F.
	Cult. after 1 hr.	F.	No F.
	Cult. after 1 day	Several hundred cols. F.	No F.
	Cult. after 2 days	No F.	No F.

INTRODUCTION OF A SECOND STRAIN OF FRIEDLÄNDER BACILLI UPON THE MUCOUS MEMBRANES OF THE CARRIER

It seemed of interest to determine how the carrier would react to the introduction of a second strain of B. Friedländer. Such an experiment was made possible by working with strains sufficiently different to enable one to differentiate the carrier's strain and the organism introduced. Carrier G. harbored an organism which had the following characteristics: Colonies up to 1 cm. in diameter, confluent; grayish white, slightly opaque, sticky growth, not very stringy; microscopically, short Gram negative bacilli with moderate capsule formation; fermentation of

sugars (twenty-four hours), saccharose +, dextrose +, mannite +, lactose 0. Carrier J.'s strain grew with a profuse, opalescent, very sticky and stringy growth. Short Gram negative bacilli with very marked capsule formation; fermentation of sugars (twenty-four hours), dextrose +, mannite +, saccharose 0, lactose 0. When a mixture of these two strains was grown on the same plate it was readily possible to pick out the two different types of colonies. After control cultures had been made, each of these two carriers was inoculated with the other's strain,

TABLE 5

Introduction of a second strain of B. Friedländer upon the mucous membranes of the carrier

NAME	DATE	
G	March 28	Control culture before inoculation (pharynx) = ∞ cols. strain G. A large loopful of strain J. (fished from the original plate) was swabbed on G.'s tongue and pharynx.
		Culture made immediately (pharynx) = ∞ cols. strain J.—6 cols. G.
		Culture made after 2 hours (pharynx) = ∞ cols. strain G.—no cols. J.
		Culture made after 24 hours (pharynx) = ∞ cols. strain G.—no cols. J.
		Culture made after 48 hours (pharynx) = ∞ cols. strain G.—no cols. J.
J	March 28	Control culture before inoculation (pharynx) = ∞ cols. strain J. A large loopful of strain G. (fished from original plates) was swabbed on J.'s tongue and pharynx.
		Culture made immediately (pharynx) = ∞ cols. strain G.—no cols. J.
		Culture made after 2 hours (pharynx) = many cols. strain G.—many cols. J.
		Culture made after 24 hours (pharynx) = many cols. strain J.—no cols. G.
		Culture made after 48 hours (pharynx) = ∞ cols. strain J.—no cols. G.

and cultures were made at various intervals. The result of this experiment (table 5) is that the foreign strain replaces the carrier's strain in the cultures for a few hours, but promptly disappears, so that after twenty-four hours only the carrier's strain is recovered. In other words a carrier reacts to the introduction of a second strain of B. Friedländer just as a noncarrier does. This experiment seems to show then that there is no special alteration in the mucous membranes of the carrier which makes them a suitable medium for the growth of Friedländer bacilli in general.

ATTEMPTS AT CARRIER PRODUCTION

An attempt was made to produce artificially a carrier state by frequent reinoculations. An individual, B., was inoculated by swabbing the tongue with a freshly isolated strain of B. Friedländer. Cultures were taken at various intervals following inoculation and daily reinoculations were made with these cultures. This process was repeated daily for one week. Within twenty-four hours after the last inoculation B. was free from B. Friedländer. This result was the expected one and lends some support to the view that a focus of infection is responsible for the carrier state in the case of this organism.

DISCUSSION

The present report, in summary, presents experimental evidence on the mechanism of the carrier state, at least in certain instances. It has been possible to show in the case of these Friedländer bacillus carriers that the breeding place of the bacteria is in a definite focus,—the tonsil. From this point the organisms are discharged into the open pharyngeal cavity, and at times may be introduced into the nose. There is no evidence, however, to indicate that any adaptation takes place between the bacilli and the mucous surfaces, leading to actual growth and multiplication on these surfaces. They react just as the normal mucous membranes do, both on introduction of the carrier's own strain, or on the introduction of a second strain of Friedländer bacilli.

CONCLUSIONS

1. Of 85 unselected individuals, 5.8 per cent were found to be carriers of B. Friedländer.

2. The carrier state persisted throughout the period of observation.

3. There was no tendency for contacts to acquire the carrier state.

4. Differential cultures showed the breeding place of the Friedländer bacilli to be in the tonsil.

5. The carrier's own strain or a foreign strain of B. Friedländer implanted upon the free surfaces of the mucous membranes disappeared at the same rate of speed as in a noncarrier.

6. It was impossible artificially to produce a carrier state by repeated inoculation with B. Friedländer.

7. The general conclusion of these observations is that the carrier state depends on a focus of diseased tissue which affords a breeding place for the bacteria. The organisms do not become adapted to growth on the free surfaces of the mucous membranes.

REFERENCES

(1) Bloomfield, A. L.: Amer. Rev. Tuberc., 1920, iv, 247.
(2) Pilot, I., and Davis, D. J.: Jour. Infec. Dis., 1919, xxiv, 386.
(3) Tongs, M. S.: Jour. A. M. A., 1919, lxxiii, 1050.
(4) Van Dyke, H. B.: Ibid., 1920, lxxiv, 448.
(5) Herrold, R. D.: Ibid., 1918, lxx, 82
(6) Bloomfield, A. L.: Bull. Johns Hopkins Hosp., 1920, xxxi, 203.

CONDITIONS COMMONLY MISTAKEN FOR PULMONARY TUBERCULOSIS

REPORT OF A STUDY OF 1700 CONSECUTIVE CASES

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In gathering statistics of faulty diagnoses it is the privilege of the specialists to lay the blame at the door of the general practitioner. That the specialists can find no such comfort in the case of tuberculosis is quickly recognized by anyone who has occasion to check up the correctness of the diagnoses as made by many experts in this field. At our sanatorium an unrivaled opportunity presented itself to check the diagnoses of general practitioners as well as specialists in tuberculosis, because it is only on the strength of a positive diagnosis, corroborated by at least one specialist, that patients are admitted for treatment.

We are constrained to say, although it is not the intention to be severe in judgment on the mistakes of others, that there is a general failure on the part of many physicians, not excluding specialists, to realize that not all chest conditions can be interpreted on a basis of pulmonary tuberculosis. Furthermore, the impression is gained that no earnest attempt is really made to differentiate between tuberculous and nontuberculous affections of the lungs. We feel, therefore, that it is entirely pertinent to call attention to the number of unwarranted positive diagnoses in the last 1700 supposedly tuberculous individuals admitted to our institution, and to discuss briefly the differential diagnosis of those diseases which were most frequently confounded with phthisis.

In our series 176, or 10.4 per cent, were found to be nontuberculous. But while there is a possibility that the final diagnosis at the sanatorium may have been incorrect in some cases, especially since for obvious reasons but few necropsies were obtained, nevertheless, judging from post-mortem findings in institutions for the advanced tuberculous, it seems that if we erred we did so on the side of caution.

Ash (1) found 11.6 per cent nontuberculous in 198 necropsies at the Boston Consumptive Hospital. He also collected a series of 353 nec-

ropsies in other institutions for the advanced tuberculous, of which 38, or 10.9 per cent, were nontuberculous. In a more recent study of 1200 cases McCrae and Funk (2) found 6 per cent nontuberculous on clinical examination and 5.2 per cent nontuberculous on postmortem study of advanced tuberculous cases.

The following conditions were erroneously considered as phthisis pulmonalis in our series:

Chronic bronchitis and emphysema	32
Cardiac conditions	18
Nonspecific diseases of the upper respiratory tract	15
Neurasthenia	15
Chronic interstitial pneumonia	12
Bronchiectasis	10
Chronic nontuberculous lung infections	11
Asthma	4
Gastric ulcer	3
Pulmonary abscess	4
Dysthyroidism	4
Miscellaneous cases: dementia praecox (2), maniac depressive insanity (2), tuberculous peritonitis (2), systemic syphilis (2), aortic aneurysm (1), malingering (1), pulmonary infarct (1), diabetes mellitus (1), pregnancy (1), no definite diagnosis (33)	
Total	176

The various groups are given in detail:

CHRONIC BRONCHITIS AND EMPHYSEMA

Thirty-two cases

It is not generally appreciated that patients suffering from bronchitis and emphysema at times expectorate blood. It is perhaps for this reason and the fact that they cough and present numerous adventitious sounds in their chests that they are so often considered tuberculous. These patients gave a history of cough and expectoration of many years duration, and frequent attacks of bronchitis during the winter months. At times their sputum was bloodstreaked. Their general health was good and they disclaimed toxic symptoms of phthisis. Numerous adventitious sounds could be heard all over their lungs; but resonance over the upper lobes remained unimpaired. Acid-fast bacilli could not be demonstrated in their sputum and roentgenologic examinations showed thickened linear shadows running from the hilum regions towards both bases, but no evidence of tuberculous infiltration.

A differential diagnosis can be made along the following lines: In chronic bronchitis cough and expectoration date back many years and even to childhood, and yet the general health leaves little to be desired. Adventitious sounds are heard all over the chest but resonance over the apices remains unimpaired. Chronic bronchitis is often secondary to heart and kidney conditions and complications common in tuberculosis are absent in this disease. On the other hand in phthisis a history of toxemia is almost always obtainable and the general health has suffered considerably. Tuberculosis affects the upper lobes almost invariably and when the numerous adventitious sounds are due to this disease the sputum will be found to contain tubercle bacilli. Tuberculous complications are present in a large proportion of cases. Tuberculosis is mainly a disease of adolescence and adults before thirty, while chronic bronchitis is frequently a disease of the aged. Fifty per cent of the patients in this group were fifty-five years of age and over. Experience teaches that it is not safe in most instances to diagnose tuberculosis in this sixth decade on a meager history, unless the diagnosis is supported by positive sputum and roentgenologic findings.

CARDIAC CONDITIONS

Eighteen cases

Although there are no pathognomonic symptoms of phthisis, cough, expectoration, failing health, and hemoptysis have long been considered indicative of tuberculous disease. Patients suffering from mitral disease very often complain of similar symptoms. It is undoubtedly due to this similarity in symptomatology that so many "cardiacs" are pronounced tuberculous. This group of cases was most numerous in the series of faulty diagnoses collected by McCrae and Funk and by Ash. Fifteen of our cases had mitral disease and in 9 of these mitral stenosis was easily detectable. It is a notorious fact that those who suffer from mitral disease are very rarely affected with tuberculosis. Brown (3) collected figures of 71,115 autopsies with but 0.9 per cent of valvular heart disease in phthisis. Birch-Hirschfeld found only 3 cases in 4,359 autopsies in which mitral disease and tuberculosis coexisted. Statistics like these show conclusively that it is hazardous. to diagnose tuberculosis in "cardiacs," unless the sputum or roentgenologic findings are positive. In this connection it is pertinent to mention that positive sputum reports are not incontestable. Samples are frequently mixed,

labeled wrongly and clerical errors will occur, especially in the large laboratories. A rule should therefore be made that when the diagnosis rests on the sputum findings, positive reports must be confirmed. Two of our cases came with positive reports from reputable hospitals. In one, not another positive sputum could be found in 69 examinations. The other came to autopsy and no tuberculous lesion could be found.

NONSPECIFIC DISEASES OF THE UPPER RESPIRATORY TRACT

Fifteen cases

Fifteen patients suffering from acute affections of the upper respiratory tract were diagnosed as tuberculous on account of the fact that their consorts were tuberculous. Of late there have appeared so many feverish reports about the great frequency of conjugal phthisis that many would be led to believe that the disease is most frequently propagated by cohabitation. That this is not the case will be admitted by those who are able to differentiate between tuberculous disease and tuberculous infection. At our sanatorium where, until recently, no objection was raised to the admission of man and wife, tuberculosis in both consorts was rarely found. Nor were we often able to find clinical tuberculosis in patients whose consorts were confined to other institutions for the phthisical. In the few instances of definite tuberculosis in both consorts we were able to ascertain that the disease existed in both before the marriage was contracted.

In the light of cold study it would seem that conjugal tuberculosis is accidental. It is the opinion of most reliable authorities (4) (5) that the chances of tuberculosis occurring in both consorts are about the same as in cancer and insanity. Says Fishberg (6),

> Inasmuch as the phthisical consort has already been infected with tuberculosis in childhood, all new opportunities for reinfection by cohabitation with a tuberculous consort are of no avail to produce phthisis. It is her or his constitution that determines whether consumption will develop and not the opportunity for reinfection.

Consorts of the tuberculous are not exempt from acute colds. When they are so affected, tuberculosis is rarely the etiological factor. Each case must be considered on its own merits.

NEURASTHENIA

Fifteen cases

The term neurasthenia covers a multitude of uncertainties. Whether patients so diagnosed were suffering from neurocirculatory asthenia or associated disorders is not strictly within the scope of this discussion, but they were not ill with tuberculosis. They complained of indefinite pains and aches and were constitutionally inferior. Their histories were unreliable, and they were very prone to suggestion. They felt that they could not do a day's work, and welcomed a diagnosis of a definite chronic ailment. Many of such patients make the rounds of numerous sanatoria and refuse to believe that they are not tuberculous. As a rule such patients will give a typical history of phthisis if they are informed of the symptomatology of this disease, but all methods of examination will fail to disclose pathological changes in their lungs.

CHRONIC INTERSTITIAL PNEUMONIA

Twelve cases

Chronic interstitial pneumonia was overlooked in 12 cases before admission. In 5 of these fibroid phthisis could be excluded only after a long period of observation. However, if we bear in mind that interstitial pneumonia is most often a unilateral affection and occurs more frequently in the young, in contradistinction to fibroid phthisis which is rarely unilateral and occurs mostly in people over forty, a correct diagnosis will be reached. These patients gave a history pointing to unresolved pneumonia and frequent attacks of bronchopneumonia. Most of them were below eighteen years of age, and physical examination disclosed a unilateral involvement. The roentgenological findings were not conclusive but the persistently negative sputa clinch the diagnosis.

BRONCHIECTASIS

Ten cases

Ten patients suffered from this disease. Errors in this group were undoubtedly due to failure to examine the sputum carefully and to note that the lesion was situated in the lower lobes, while the apices were comparatively free from disease. Tuberculous people who expectorate profusely and have extensive involvement of the lower lobes are hectic.

emaciated and soon moribund, and invariably have myriads of tubercle bacilli in their sputum. On the other hand, these bronchiectasis patients got along comfortably, and were well nourished and free from constitutional symptoms in spite of their extensive lower lobe involvement and profuse and at times foetid expectoration. It is safe to consider basal lesions as nontuberculous until proved otherwise. The X-rays are of assistance when showing clear apices; but basal lesions, especially bronchiectasis, are not well demonstrated roentgenologically. In general, negative findings in the sputa of patients who have extensive pulmonary lesions should excite the suspicion of the nonexistence of tuberculosis.

CHRONIC NONTUBERCULOUS LUNG INFECTIONS

Eleven cases

Eleven patients were admitted to our institution with symptoms and signs of what some authors, for want of a better term, call chronic nontuberculous lung infection. Whether this condition is really a localized bronchitis and lobular pneumonia (7), which may later turn into interstitial pneumonia and bronchiectasis (8), has not yet been determined, and probably will not be easily ascertained on account of inadequate postmortem studies. Some authors (9) (10) describe an acute, subacute and chronic form of this disorder, but scrutiny of this subject shows that the last word has not yet been said about this condition. These patients gave a history of moderate cough and expectoration of many years duration following an acute respiratory condition resembling the grippe in manifestation. Their general health left little to be desired, and so far as we were able to ascertain they had no recurrent symptoms of toxemia. Dulness and diminished breathing with small moist râles were the signs usually elicited at either or both lower lobes. The roentgenological findings at the site of the lesion were insignificant but the apices were invariably free from abnormal densities, thus excluding the presence of a parenchymatous tuberculous lesion. Numerous examinations of the sputa of all these cases failed to disclose the presence of acid-fast bacilli. We did not encounter this condition at the upper lobes. Tuberculosis on the other hand is essentially an upper lobe affection; and when cough and expectoration of long duration are due to this disease, a history of toxic symptoms can be usually elicited; the sputum will show the presence of acid-fast bacilli and the roentgenological findings will disclose definite evidences of infiltration.

It is of interest to note that at our sanatorium we have seen but very few postinfluenzal chest conditions resulting from the recent pandemic, in spite of the fact that our patients come from neighborhoods where the disease was particularly rampant. Possibly the high scale of wages and good returns in business enterprises keep many at work who otherwise would seek institutional care.

ASTHMA

Four cases

The 4 cases of asthma were never subjected to X-ray examination nor was their sputum carefully studied. While the dictum that "asthma and tuberculosis occupy a relation of mutual exclusion" is not necessarily incontrovertible, a diagnosis of tuberculosis in an asthmatic should not be made unless tubercle bacilli are found in the sputum or the X-ray findings are indisputable.

GASTRIC ULCER

Three cases

In 3 cases the gastric disturbances of early phthisis were relied on for a final diagnosis. Gastric ailment, loss of weight, and failing health, were what these patients complained of. One had severe hematemesis which prior to admission was mistaken for hemoptysis. It is indeed difficult at times to differentiate between hematemesis and hemoptysis and many an experienced physician has thus been led to err. Blood coughed up may be swallowed and then vomited and conversely blood vomited may be aspirated and then coughed up. In either case blood will be found in the stool. But there is one sign which may be helpful; if the patient after the initial gush of blood continues to expectorate blood streaked sputum for several days the hemorrhage came from the lungs. On the other hand, if no streaked sputum follows the initial loss of blood, the bleeding is extrapulmonic.

PULMONARY ABSCESS

Four cases

Reliance on symptoms alone and failure to study the sputum carefully probably accounted for the errors in this group of cases. Given a patient with a history of cough, expectoration, high fever and rapid

emaciation, immediately following a septic process or pneumonia, and expecially a surgical operation of the upper respiratory passages, the existence of abscess of the lung cannot be excluded unless tubercle bacilli are found in the sputum.

DYSTHYROIDISM

Four cases

Although the determination of the basal metabolism was not resorted to, 4 instances of dysthyroidism were detected. They presented the cardinal signs and symptoms of this condition, and were free from pulmonary disease.

MISCELLANEOUS CASES

We found 2 each of the following: gastric malignancy, dementia precox, maniac depressive insanity, tuberculous peritonitis, and systemic syphilis; and 1 each of aortic aneurysm, malingering, pulmonary infarct, diabetes mellitus and pregnancy. The aortic aneurysm was shown by the roentgen ray. The malingerer purchased tuberculous sputum and presented it for examination; while the pulmonary infarct followed massage of unusually prominent and somewhat inflamed varicose veins of the lower extremities.

In 33 cases no definite abnormalities could be detected. They were in good health and probably welcomed a vacation.

COMMENT

It has been stated that tuberculosis is overlooked ten times more often than it is diagnosed. This may be true of that part of the population which offers little opportunity for clinical investigation. But tuberculosis is unquestionably much overdiagnosed in those who for some reason present themselves for examination in the clinics of large municipalities.

Scrutiny of the foregoing data discloses the fact that the errors in the diagnoses were due to lack of care and thoroughness, failure to examine the sputum carefully, disinclination to utilize the roentgen rays, and, above all, failure to correlate the history and clinical findings. It does indeed seem as if some health agencies consider most individuals, who for some reason present themselves for examination, as tuberculous until

proved otherwise. This is difficult to understand, but is supported by the fact that incorrect diagnoses emanate from these sources with amazing frequency, regardless of the diagnostic standards laid down by wellmeaning scientific bodies.

The disastrous results of this state of affairs are far-reaching and cannot be adequately described in a short communication. Suffice it to say that for many patients a diagnosis of tuberculosis means absolute neglect of the real cause of the complaint and not infrequently irreparable damage is thus done. On the other hand fairly healthy individuals once diagnosed tuberculous, become permanently dependent economically. They acquire a selfish attitude and will not attempt to support themselves for fear of a breakdown as a result of such efforts. These newly created hypochondriacs make the rounds of many easily accessible sanatoria and insist that they are in need of treatment and refuse to be convinced to the contrary. Others are ostracized by their families and are refused employment in reputable establishments for fear of spreading the disease.

How often happy families are disrupted, lucrative businesses sold out, children committed to asylums and preventoria, and innocent people banished to distant climatic health resorts, it is impossible to estimate, but judging from our experience such instances are by no means infrequent. Funds from public coffers are wasted, and for lack of accommodation, the real tuberculous are often put on the waiting list. And the guilt must be laid at our door.

That this unfortunate circumstance requires serious consideration there can be no doubt. The welfare of the community demands that more caution be exercised in the diagnosis of phthisis.

SUMMARY

1. Among the last 1700 cases sent to us suffering from tuberculosis, 176 or 10.4 per cent were nontuberculous.

2. The conditions most frequently diagnosed incorrectly were: Chronic bronchitis and emphysema, cardiac conditions, nonspecific diseases of the upper respiratory tract, neurasthenia, chronic interstitial pneumonia, bronchiectasis, chronic nontuberculous lung infections, asthma, gastric ulcer, pulmonary abscess, dysthyroidism.

3. It is hazardous to diagnose tuberculosis in individuals over fifty and those suffering from mitral disease, unless sputum or X-rays are positive.

4. It is safe to consider lesions confined to the lower lobe as nontuberculous until proved otherwise.

5. Marital phthisis is exceedingly rare. Tuberculosis in one consort has no definite etiological relation to phthisis in the other.

6. Extensive unilateral lesions are often nontuberculous, while advanced phthisis is usually bilateral.

7. Positive sputum reports are not incontestable. When the diagnosis rests on the presence of acid-fast bacilli in the sputum, the findings must be confirmed.

8. Care and thoroughness, sputum studies, free use of the roentgen ray, and, above all, the proper correlation of history, symptoms and physical findings, will make for more accurate diagnosis and more intelligent treatment.

REFERENCES

(1) Ash, J. E.: The pathology of the mistaken diagnoses in a hospital for advanced tuberculous. Jour. A. M. A., 1915, lxiv, 15.

(2) McCrae, T., and Funk, E. H.: The diagnosis of chronic pulmonary tuberculosis. Jour. A. M. A., 1919, lxxiii, 161.

(3) Brown, L.: Am. J. Med. Sc., 1904, cxxxvii.

(4) Pope, E.: A second study of statistics of pulmonary tuberculosis. Marital infection. London, 1911.

(5) Pearson, K.: Tuberculosis heredity and environment. London, 1912.

(6) Fishberg, M.: Pulmonary tuberculosis. Lea & Febiger, New York and Philadelphia, 1918, p. 125.

(7) Hamman, L., and Wolman, S.: Tr. Nat. Ass. Study and Prev. Tuberc., 1916, 171.

(8) Lord, F. T.: Boston Med. and Surg. J., 1905, clii, 537.

(9) Miller, J. A.: Chronic nontuberculous lung infections. Am. J. Med. Sc., 1917, cliv, 805.

(10) Field, C. G.: Chronic nontuberculous lung infections. Am. J. Med. Sc., 1920, clix, 442.

A RECENT STUDY OF THE INDIGENT MIGRATORY CONSUMPTIVE PROBLEM[1]

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In our study of the migratory consumptive question I have been convinced that we have had no reliable data on which to base an estimate as to the cost or extent of this problem in the Southwest. It is true that we have some careful studies made several years ago and that a general survey of the migratory consumptive evil has been in the process of preparation during the past year. I have felt, however, that the better way to get the exact facts in this matter is to take a typical resort community, one to which consumptives come from various parts of the country, and to send into that community one of our field workers to intensively study, and personally interview these migratory consumptives.

It is especially true that in the State of Texas there are a number of consumptives who have come to this State for better health. Undoubtedly, if these migratory consumptives were placed in sanatoria, benefit would come both to themselves physically and to the State economically. However, it may be easily seen that if these wanderers enter the State without being financially well fixed or with little savings, or without being able to work except at intervals, these migratory consumptives are neither fair to their own health nor to the economic condition of the community in which they settle.

In this survey no attempt had been made to present any argument in the solving of the problem of the indigent migratory consumptive. I have here merely placed figures which may be studied in order to show the extent of this problem within a typical health resort community to which, naturally, these migratory consumptive persons wander.

MORTALITY STATISTICS

The population of the community under discussion is approximately 16,000. The mortality statistics that I am going to give you are compiled for the year beginning September 1, 1918, and ending September 1,

[1] A digest of remarks made at the Southwestern Tuberculosis Conference, October 2, 1919.

[2] Executive Secretary, Texas Public Health Association.

1919. Their authenticity I am able to vouch for. During the year under discussion there were 208 deaths in this community with its population of 16,000—the death rate being therefore 1300 per 100,000. This you will see is slightly below the death rate of the United States at large, which is reported as 1420 per 100,000.[3]

Of the 208 deaths, 80 were caused by tuberculosis, or a death rate from this disease in the community of 500 per 100,000. Since the tuberculosis death rate for the United States is estimated as 146.6 per 100,000,[3] it is evident that this excessive death rate from tuberculosis is caused by the great amount of migration of tuberculous people into this community.

PLACE OF BURIAL

Let us look for a moment at the places where the burial of those who died from tuberculosis took place. Thirty-four were buried at the place of death, while 46 were removed to other places—16 of these to other States. It will, therefore, be seen that the bodies of 46 people who died of tuberculosis in this community were taken away from this town for burial. This would tend to show the great number of people who came to this community from other places and made this their temporary home.

RESULTS OF PERSONAL INVESTIGATION

Not only was a study made of burial certificates and death rates, but 193 people who had tuberculosis were personally interviewed by our investigators. Many of those who were interviewed lived in typical health resort districts of small open air bungalows.

As a sidelight on the cost of the migratory consumptive to the community in dollars and cents, let me say that I am informed by the head of an organization, which is responsible for relief work in this community, that during the 12 months covered by the survey the organization has spent $1,128.77 on 20 indigent tuberculous people, and that over 40 of them applied to him for financial aid. A list of the names of these 20 indigents who were assisted was given to our investigators who were able to locate only six of them. The remainder had evidently roved on to other places. This shows that there were a great many wanderers

[3] United States Public Health Report, July 4, 1919.

who came into this community and left within so short a time, that our investigators were not able to find them.

However, very interesting figures come from the investigation of those who have come into this community in search of health and have settled even for a short time.

These figures tend to indicate the economic loss occasioned by a tuberculous person entering a community without sufficient financial means, not to mention the bad effect upon his health of a long, dusty, tiresome, worrying railroad journey, which assuredly greatly weakens his vitality.

Of the 193 persons interviewed, 97 were male and 96 female. It is interesting to note also that 70 of these 193 were single; that is, 36.27 per cent of the total number. To these 70 who were single may be added 20 more who were either widowed or divorced, in order to determine the number without marriage ties or responsibilities. This makes a total of 90 or a percentage of 46.63 per cent of those interviewed.

OCCUPATION

We were especially interested in seeing what the previous occupation of these people had been, and what was the occupation of those who were at the time of the survey able to work. We found that 72 or 37.30 per cent of the total number were high class business men, had a profession, or workers in trades or skilled occupations. Sixteen, or 8.29 per cent of them had been farmers. The housewives total 52, or 26.94 per cent, of whom 42 had children. Nine, or 4.66 per cent, were common laborers. Forty-four, or 22.8 per cent, were in unclassified occupations, including school boys and girls or those without any occupation.

It is important to note that 16 farmers, even though engaged in a healthful, outdoor occupation, were victims of tuberculosis.

PRESENT FINANCIAL CONDITION

We have attempted also to find out something about the financial condition of these health seekers. Very few of them seemed to object strenuously to giving information to our investigators, even upon such a personal matter as their financial status. In fact, most of them seemed to realize that the survey was being made to benefit their condition and that of other consumptives throughout the country. They were entirely willing to give any information which would make plain the conditions at these health resorts.

It is selfevident that those who are dependent on relatives, on friends or charity, or upon limited savings or labor, which may cease in case their health should fail them to any great extent, are in a somewhat precarious financial condition and that the withdrawal of such support, the using of small savings, or the loss of work might throw them upon the charity of the community. Out of these 193 tuberculous persons interviewed, 63 were in a precarious financial condition. This is 32.64 per cent of the total number. Of these, 21 were dependent on relatives other than parents or children. Fifteen were dependent on friends or charity, while 20 were dependent upon small savings or labor, which might cease at any time through sickness.

There are also 7 who have a legal claim for support upon some relative such as parents upon their children or children upon their parents, yet those who support them are not well able to do so.

It will be seen, therefore, that out of the 193 people who are known to be tuberculous in this community of 16,000, there are today 63 people to whom the loss of a day's work or the loss of an income from friends or relatives would mean destitution. Of these 63 people who are in a precarious financial condition, 56 have come to this community from other cities or states. This is, it seems to me, an indication that many of those who have come to this place for health are unable to support themselves, and are liable at any time to become an economic charge to the community.

One hundred and thirty or 67.36 per cent were considered by our investigators as being in an apparently financially safe condition. The large number of these were men and women who came here years ago and who have so far as possible recovered their health, and remained and engaged in business. A number of these also were wives of business men who had been urged by physicians to go West on account of their wives' health. Practically all of those who have been considered as financially safe are engaged in some business which will permit of some leniency as to working hours, etc., in case of a breakdown of health, or engaged in some profitable business from which there is a steady income, or have a substantial savings account.

STATES WHERE DIAGNOSED

It is interesting to note the many and varied placed from which these wanderers come. Of the 193 cases interviewed, 66 were diagnosed as

tuberculous in other states. The states which contributed the largest number of these migratory consumptives are Tennessee and Oklahoma, which provided 10 each. Arkansas ranks next with 8; Illinois, Missouri, Mississippi and Louisiana follow with 5 each. You will notice that I am mentioning states where the disease was diagnosed. This does not include a large number of people who have been advised to go West because they had "some form of lung trouble, but not tuberculosis;" or the other group who were anaemic and to whom a "change of climate would be advantageous." We all know that the big majority of this type of people are actually tuberculous at the time they leave their homes, and if they knew the truth they would understand that they are being sent to the southwest because of tuberculosis.

Of the 127 cases interviewed which were diagnosed in Texas, 106 were diagnosed at some place within the state other than the community in which the survey was made. In summing up we may say that 34.2 per cent of those interviewed came to Texas from other states suffering from tuberculosis while 54.9 per cent came from some other place within the state, leaving only 21 or 10.9 per cent of the cases as actually diagnosed within the community; or a total of 89.1 per cent of those interviewed had come to this community from other places.

NUMBER WHO HAVE TRIED OTHER PLACES

To further show the extent of the wandering of these consumptives, the fact may be interesting that 59 of the 193 tuberculous patients had been in other communities "for their health." Sixty-four of them, or 33.16 per cent, have been in a sanatorium at some time in the past, 58 of them at the State Tuberculosis Sanatorium. These figures show that 30.5 per cent of this entire group have been wandering about to a greater or less extent, looking for a place where they could recover their health.

LENGTH OF TIME IN THIS COMMUNITY

An index to the migratory consumptive problem may be found in the length of time tuberculous persons stay in any one place. It is self-evident that there is danger in the migration of tuberculous people from place to place. Fifty-four out of 193 cases of tuberculosis actually interviewed have been in this community less than 90 days; 46 more have been there from 3 months to a year. This means that there are an even

100 out of the 193 who are suffering from tuberculosis that have lived in the community for less than 12 months. Do not forget that the community has a population of 16,000, which tends to show that one out of every 160 people in this town is a consumptive who has come there within the last year. These figures show the tendency of the migratory consumptive to stay in a place for only a short time, and then wander on in search of health.

KNOWN FAMILY HISTORY

It has, of course, been practically impossible for us to get any statistics on the cause of infection, although it is easily recognizable that the consumptive who brings children to the state has made greater the chances for the rearing of tuberculous children in Texas through personal contact. It is a well known fact that data on the cause of infection is difficult to secure. We are interested, however, to see that out of the 193 interviewed, 103 or 53.37 per cent reported that to the best of their knowledge some member of their family had had tuberculosis in times past.

CONCLUSION

I offer these statements and figures as a small bit of evidence that the migratory tuberculosis problem is to-day an acute one in the Southwest. I am convinced that until some such study is made in many communities throughout the Southwest, we will have little actual basis upon which to place our requests for legislation to prevent the indigent migratory consumptive from entering the state, or at least care for him.

STATISTICS OF SURVEY

This survey was made by field workers of the Texas Public Health Association during August and September, 1919. It covers the year from September 1, 1918, to September 1, 1919.

Mortality statistics

Total deaths, September 1, 1918–September 1, 1919	208
Estimated population of city	16,000
Death rate of city per 100,000	1,300
Death rate in the United States per 100,000	1,420
Tuberculosis deaths in city, including 12 from influenza and pneumonia where tuberculosis was contributing cause	80
Tuberculosis death rate per 100,000 in city	500
Tuberculosis death rate per 100,000 in the United States	146.4

Place of burial

		per cent
Removed to other places	46	57.5
Other places in Texas	30	37.5
Other States	16	20.0
Buried in city	34	42.5

Persons interviewed

Number, having tuberculosis, interviewed	193	
Male	97	50.26
Female	96	49.74

Marital relation

Single	70	36.27
Married	103	53.37
Widowed or divorced	20	10.36
Number having children	92	47.67

Occupation

High class business	14	7.25
Professional	18	9.33
Trades or skilled occupations	40	20.73
Farmers	16	8.29
Common workers	9	4.66
Housewives	52	26.94
Other occupations	20	10.36
No occupation (school boys, etc.)	24	12.44

Present financial condition

Apparently financially safe	130	67.36
Precarious financially	63	32.64
Dependent on relatives	28	14.51
Dependent on parents or children	7	3.62
Dependent on friends or charity	15	7.77
Dependent on own labor or limited savings	20	10.36

Places where diagnosed

Texas	127	65.8
(City surveyed. .21 10.88 per cent)		
Other states, countries, etc	66	34.2
Oklahoma and Tennessee (each)	10	
Arkansas	8	
Illinois, Louisiana, Mississippi, and Missouri (each)	5	
Alabama	4	
Kentucky	3	
New York	2	
Army, California, Minnesota, New Mexico, Nevada, Ohio, Pennsylvania, Canada, and Mexico (each)	1	

Number who have tried other places for health		
Not including those who have been in State Tuberculosis Sanatorium	59	30.57
Number who have been in a sanatorium		
Number who have been at state sanatorium	58	30.05
Number who have been in sanatoria	64	33.16
Time in city surveyed		
Three months or less	54	27.98
Three months to a year	46	23.83
One year or longer	93	48.19
Home surroundings		
Good or fair	182	94.31
Bad	11	5.69
Prospects for arresting disease		
Good or fair	158	81.87
Bad	35	18.13
Family tuberculosis history		
History known	103	53.37
No known history	90	46.63

PLEURAL INFECTION COMPLICATING ARTIFICIAL PNEUMOTHORAX TREATED WITH GENTIAN VIOLET

A PRELIMINARY REPORT

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Within the past few years various dye substances, especially those better known in laboratory work, such as methylene blue and gentian violet, have been studied with reference to their chemotherapeutic value and their action on bacteria. Churchman (1), (2), (3) has recently published observations and clinical reports on gentian violet which would indicate that it may be a valuable agent in the treatment of joint and other infections with the ordinary pyogenic organisms, particularly those of the Gram positive group, such as the pneumococcus and staphylococcus. His most extensive experience has been with infections of the knee joint, and in this connection he has devised an apparatus for irrigating and aspirating the joint cavity. After preliminary anesthesia with procain solution, he distends with physiological saline solution and withdraws, repeating until clear, then introduces a 1 : 1000 aqueous gentian violet solution for five minutes, and finally a 1 : 10,000 solution, which is allowed to remain. He has obtained excellent results in a few cases so treated, and suggests that the method may well be extended to the treatment of other infected serous membranes, mentioning the pleura.

Pyothorax consequent to the development of spontaneous pneumothorax, or to the rupture of the visceral pleura in artificial pneumothorax, occurs especially in tuberculosis resulting in an infection of the pleura, often with virulent secondary organisms in addition to tubercle bacilli. In other instances such infection may perhaps occur, as in empyemas complicating pneumonia, through the formation of a subpleural abscess, as pointed out by Moschowitz (4). The mortality of pyothorax complicating pulmonary tuberculosis has been high, and its occurrence consequent to artificial pneumothorax is frequently fatal. Recoveries have

been seen when the infection was purely tuberculous, and Cocke (5) has recently reported a recovery following open drainage, for patients in poor condition a formidable procedure, and, in the tuberculous, liable to result in persistent sinus.

The occurrence of septic infection of the pleura in two instances, during the course of artificial compression of the lung in pulmonary tuberculosis, led us to adapt to the pleural cavity a method similar to that which Churchman had described and used for the knee joint. Within twelve to twenty-four hours in the first case a marked and striking change for the better was noted, repeated to a lesser degree after the second treatment, the patient subsequently recoverng from this serious complication although marked prostration and a low fever persisted, which were associated with a fresh development of tubercle in the opposite lung. The bacteriological reports on the pleural fluid withdrawn at intervals confirmed our clinical observations.

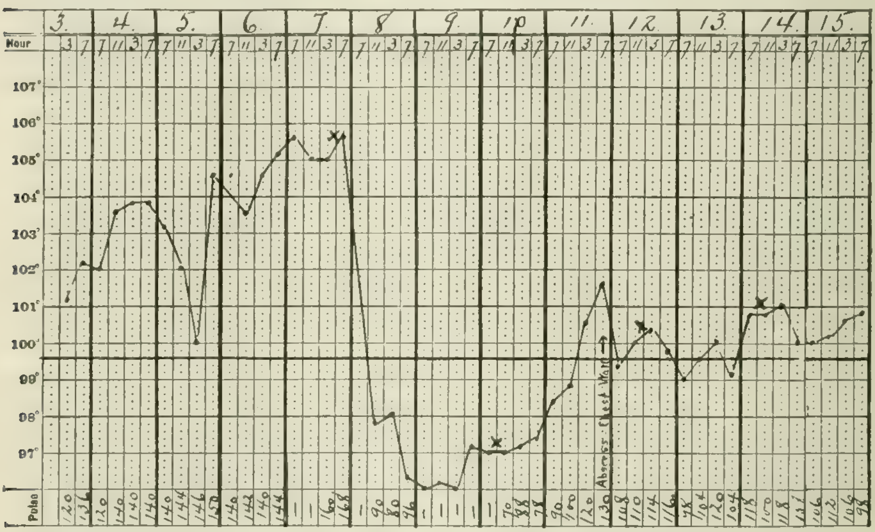
The outcome was even more gratifying in the second case, although the change in the clinical condition was perhaps not quite so striking, and again the bacteriological reports paralleled the clinical observations. These results are so unusual as to justify this preliminary report and warrant a more extended trial of the method.

CASE REPORTS

Case 1. Admitted March 9, 1919. Symptoms since early 1917. Fourteen months' previous sanatorium treatment. Contracted epidemic influenza in October, 1918. Since then continuously febrile. Extensive involvement of the left lung with cavitation. Moderate infiltration of the right upper lobe. Disease active and progressive. Sputum contained numerous tubercle bacilli. Stereograms showed evidence of diffuse infiltration and multiple cavitation of the left lung with thickened pleura and retraction of the chest, and localized parenchymatous deposits in the right upper lobe with slight peribronchial thickening below this. Artificial pneumothorax was not considered advisable or possible. Six months later the condition becoming steadily worse, and although new stereograms showed slightly more mottling in the right lung, therapeutic pneumothorax was undertaken as a last resort and with little hope of success. A fairly free pleural space was found with a rapid and marked symptomatic response. Refills in amounts varying from 300 to 500 cc. at the usual increasing intervals. Within a month the patient was practically afebrile and gaining in weight, cough and sputum being much reduced. A month later allowed to sit up out of bed and a month later transferred to a cottage for ambulatory patients. Up to this time no positive pres-

sure was required and the lung, an elongated ovid shell, occupied the region between the 3rd and 7th dorsal spines. A little later a moderate pleural effusion developed, with rapid formation of adhesions and contraction of the pleural space, and very small amounts of air (100 to 150 cc.) caused considerable rise of manometric pressure. These small refills were continued in order to prevent total adhesion and expansion of the diseased lung. Five months after beginning compression, a refill of 150 cc. had been given, with a maximum pressure of +18 +14 cm. water (corrected pressure), the reading prior to the introduction of air having been −6 −18. Following this rather high pressure the patient experienced no unusual discomfort or reaction. Three days later, however, she complained of feeling chilly and of a pain increasing in severity in the left infrascapular region. At the same time the temperature rose, reaching 104° the following day, and later 105°. Dyspnea also became noticeable with marked prostration, rapid pulse, and slight cyanosis. Dulness at the base of the chest posteriorly and a sucussion splash were noted; and 350 cc. slightly turbid fluid of an amber color were removed with some relief of pain and the sense of pressure, but with slight and temporary diminution of temperature. The fluid was highly albuminous and smears showed numerous Gram positive cocci, identified culturally as Staphylococcus aureus and a few diplococci, the morphology of which suggested pneumococci. The patient rapidly became worse and four days later with temperature of 105.6°, pulse 160, respirations 52, she seemed moribund. On March 7, 1920, the pleura was first washed with saline solution, then with a dilute gentian violet solution, and the chest was left partly filled with it. The solutions were introduced by means of a 50 cc. glass syringe through an 18 gauge Luer needle inserted in the upper axilla, and withdrawn through an aspirating needle of somewhat larger size, inserted near the base, posteriorly communicating with a Potain suction bottle. About 1000 cc. warm physiological saline solution were required to wash the pleura clean. A 1:5000 aqueous gentian violet solution was allowed to fill the chest for several minutes and was slowly withdrawn, after which as much as could be tolerated without uncomfortable pressure (about 150 cc.) was introduced and allowed to remain for the bacteriostatic effects. The following morning a striking remission of temperature was noted with a corresponding diminution in pulse and respiration rate (chart 1). The picture much resembled that of the crisis in pneumonia. The treatment was repeated the following day and continued every other day, with slight increase in the strength of the gentian violet solution, until the secondary infection was under control. The acute symptoms disappeared with improvement in strength and appetite. Temperature remained subnormal for four days and then rose coincidently with the development of a needle track abscess, and fluctuated while this condition lasted. At this time, smears of fluid which had been allowed to remain in the pleural cavity for forty-eight hours showed

a few Gram positive cocci, and a few colonies of staphylococci were grown on an agar slant, but the number was much reduced. Five days later sediment from the pleural washings contained a few diplococci and epithelial cells, but the organisms were evidently not viable as they failed to grow on dextrose broth or agar. Pus from the needle track abscess showed numerous staphylococci, which grew readily, with a few Gram positive diplococci not identified, but probably similar to those isolated from the pleural fluid. After incision and drainage a similar method of treatment was used here with satisfactory results, the surface of the wound dried clean with sterile gauze or cotton, the sinus flushed clean with warm saline solution by means of a small glass syringe, again dried, and dressings were applied with packing when necessary. The discharge gradually diminished, becoming serous in character, with final healing of the wound after a course of several weeks. Smears made from the discharge after three weeks failed to show organisms, but staphylococci grew on culture. The pleural irrigations and instillations were continued at somewhat longer intervals and it was possible to use a 1:2500 solution without indications of pleural irritation or toxic effects. A few pus cells and cocci persisted in smears from the pleural sediment with negative cultures, but within four weeks from the date of the first irrigation both smears and cultures were negative. Treatment was discontinued shortly afterwards, leaving some of the gentian violet solution in the chest, which was apparently sufficiently effective to inhibit further development of the infection. Some organisms were again recovered but



X indicates treatments give.

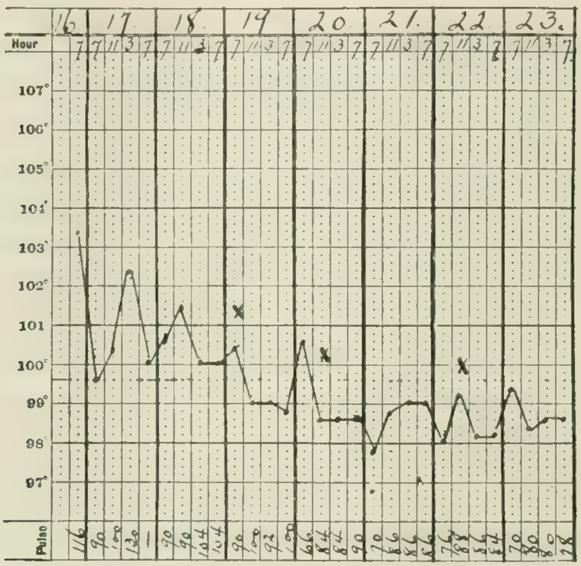
CHART 1

they failed to grow on culture media. Tubercle bacilli were not found in the smears, but guinea pig inoculation with the original exudate resulted in generalized tuberculosis, acid-fast bacilli being recovered in the smears of all the organs involved.

Case 2. Admitted February 14, 1918. Symptoms date to early December, 1917. Extensive infiltration of left upper and upper part of left lower lobes, and infiltration of upper part of right upper lobe. Sputum contained numerous tubercle bacilli. Stereograms showed severe infiltration and multiple cavitation of left upper lobe, less marked infiltration of right upper lobe. After several months of unsatisfactory progress with strict rest treatment, marked by persistent fever and several hemoptyses, artificial pneumothorax was induced on the left side. Improvement was slow and interrupted by several febrile periods, but gradually the sputum diminished from 70 grams to 7 grams daily, tubercle bacilli disappeared and moderate exercise was allowed. A small amount of pleural effusion then developed; and as it accumulated with beginning organization, it was partly aspirated and replaced by air, this operation being continued as frequently as indicated. Obliterative adhesions developed at the base with resulting contraction of the pleural space, rendering only small refills possible, at considerable intervals. While absent from the Sanatorium and probably following overexertion, and almost two years after the induction of pneumothorax, chills, fever, pains referred to the abdomen and left side with nausea and considerable fever developed, and physical signs of fluid in the left chest were confirmed by radiograph and exploratory puncture. On May 19, 1920, 750 cc. of thick gray pus were aspirated, of which stained smears showed staphylococci and a few Gram positive diplococci, both organisms growing on culture, the former greatly predominating. Tubercle bacilli were not detected in smears, but guinea pig inoculation revealed them. Treatment by lavage and gentian violet instillation was instituted in the manner already described except that at first a single needle was employed for both introduction and withdrawal of solutions. Bacteriological examination of specimens of fluid removed two days and one week later showed fewer organisms in the smears and the colonies on inoculated media. A specimen removed after eleven days showed no definite organisms and no growth, Ziehl-Neelsen stain showing occasional doubtful acid-fast rods which later on were found in more abundance. The clinical condition improved immediately after treatment, the temperature curve becoming normal within forty-eight hours (chart 2). A week later it rose moderately because of activity of the tuberculous process. Pus removed on July 18 was of a brownish-yellow color and bacteriological reports were negative. The pleura, however, was washed fairly clean through a single needle and a 1:5000 gentian violet solution again instilled, about 150 cc. being allowed to remain. The patient was then entirely afebrile and ambulatory. A month later smears showed definite acid-fast

bacilli. The pus which had accumulated was aspirated and 250 cc. of air was introduced equalizing the pressure. The further progress of the case has been satisfactory and uneventful, despite the tuberculous pleural infection.

The outcome in both these instances was so unusual and so directly connected with the method of treatment employed, that it seems more than likely that the latter played an important part in the results obtained. The general principles followed were (1) the mechanical removal of the infected exudate (pus) from the chest and thorough cleansing of the pleural surface, and (2) the application of an efficient chemical agent by



X. indicates treatments given.

CHART 2

direct and effective contact with this surface. The action of the dye on the pyogenic organisms *in vivo* Churchman characterizes as *bacteriostatic* rather than bactericidal and his experiments indicate that it has considerable powers of penetration and that its effects are manifest in comparatively weak solution. Gentian violet has an important advantage over most antiseptics and chemical agents in its low toxicity and the absence of symptoms of pleural irritation following its application in the manner described. Considerable amounts of solution can be left in the chest and it is not necessary to constantly reintroduce it or to provide continuous drainage apparatus as with Dakin's solution. Whether it

may be successfully employed in the postpneumonic empyemas, so frequently seen in general hospitals, we are not prepared to say. However, the experience of the United States Army training camps has shown that the ordinary methods of treatment have been in many respects unsatisfactory. This is well brought out by Moschowitz (4), who advocates delaying operation beyond the formative stage and following it by irrigation with Dakin's solution and suction-drainage. Consequently, any auxiliary procedure based on rational grounds and a practical method which may be applied in the earlier stages of pus formation, deserves careful consideration. No inference is justified from our experience that the procedure should postpone or supplant operation when it is indicated.

An interesting point in connection with the cases here reported is that of possible pleural communication with a bronchus. The fact that violet colored expectoration was not noted in either case negatives the probability of such communication and perhaps, also, the occurrence of pyothorax in the usual way by rupture of the outer wall of a cavity and suggests instead the lymphatic route of infection.

The demonstration of tubercle bacilli in the pus in both cases and their persistence after secondary infection was overcome, confirm the observation of record (6) that they are much less sensitive to gentian violet than are the ordinary pyogenic cocci. Alone, however, tubercle bacilli appeared in both cases to be fairly well tolerated by the pleura while the pyogenic infection produced acute and grave symptoms.

The collation and preparation of the clinical data upon which this report is based is the work of the members of the Medical Staff of Loomis Sanatorium, who deserve the greatest credit for their skilful management and careful observation of these cases.

REFERENCES

(1) Churchman, J. W.: Treatment of acute joint infections by lavage and direct medication. Jour. A. M. A., April 13, 1918.

(2) Churchman, J. W.: Selective bacteriostasis in the treatment of infections with gentian violet. Ibid., January 17, 1920.

(3) Churchman, J. W.: Gentian violet in the treatment of purulent arthritis. Ibid., August 28, 1920.

(4) Moschowitz, A. V.: Newer conceptions of the pathogenesis and treatment of empyema. Am. J. Med. Sc., May, 1920.

(5) Cocke, C. H.: Spontaneous pneumothorax following artificial pneumothorax with operation and recovery. Amer. Rev. Tuberc., February, 1920.

(6) Petroff, S. A.: A new and rapid method for the isolation and cultivation of tubercle bacilli directly from the sputum and feces. Jour. Exp. Med., January, 1915.

TUBERCULOSIS FROM THE STANDPOINT OF THE POSTMORTEM[1]

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The autopsy affords a most important opportunity for studying the incidence and character of tuberculous processes. The knowledge thus gained is supplementary as well as complementary to that obtained by the study of living patients. Any approach to complete understanding needs both methods. Neither is adequate without the other.

As with the clinical examination, however, the extent and thoroughness of the pathological survey profoundly influences the accuracy and breadth of the observations and also the conclusions. For example, one pathologist may perform a thousand autopsies and his records will contain references to only frankly outstanding tuberculous lesions. Another, by exercising the most painstaking search, perhaps employing X-ray photographs to detect tiny calcareous masses, and by a narrow interpretation of his facts, may thus demonstrate an extraordinarily high incidence of the disease. For many years I have been especially interested in the occurrence and types of tuberculosis found in the human body and as the result of this study, have reached certain conclusions, which, I believe, have a distinct bearing on some of the problems which have so long concerned workers in this special field.

Our first concern is with the general incidence of tuberculosis. We are all familiar with Naegeli's startling announcement of the finding of tuberculous foci in 97 per cent of 500 autopsies performed at Zürich, and Burkhardt's almost equally ominous percentage of 91 in 1262 postmortems in Dresden. While other pathologists give figures ranging from 30 to 60 per cent, Harbitz's estimate of 50 to 70 per cent for all ages seems to more nearly express the usual finding in this country. Exact figures are not only of little importance but are exceedingly difficult to obtain. Inaccuracy of observation as well as the difficulty of interpreting tiny healed lesions make certain a varying amount of error. From my own

[1] Read at the Eighth Meeting of the Mississippi Valley Tuberculosis Conference, Duluth, Minnesota, September 4, 1920.

observations extending over a period of fifteen years, I should estimate that nearly 50 per cent of all people of all ages show the presence of either healed or active foci of tuberculosis. Of the remaining 50 per cent, certain evidences may be presented that would lead one to believe that fully one-half of these, at some period of their life, have been menaced by virulent tuberculosis bacilli. This high incidence means that there is no *rule of immunity* on which we may rely. Like the risk of illuminating gas poisoning or being run down by an automobile, our only sure safety lies in complete avoidance of the cause.

The next consideration deals with the character of the lesions found at autopsy by means of which a diagnosis of tuberculosis is usually made. They may roughly be arranged by classes in the order of frequency of their occurrence. The most common lesion found is an old healed pleuritis with or without fibrous adhesions. These vary all the way from a slight opacity of the apical pleurae, often with puckering, to complete obliteration of one or both pleural cavities. As confirmatory evidence of the tuberculous nature of such processes I am accustomed to insist that there must also be present calcareous or caseous lymph nodes, either at the hila of the lungs or around the lower portion of the trachea.

Next in frequency is met evidence of old healed miliary tuberculosis of the lungs, spleen and liver. This evidence consists of tiny, rounded, yellowish, sharply circumscribed, hyaline nodules, ranging in diameter from a fraction of a millimetre to a centimetre. These are not so common in the lungs as in the spleen and liver; and of these two organs the nodules are more numerous and reach a larger size in the spleen than in the liver. After these lesions, in order of occurrence, one finds outspoken evidences of lung tuberculosis, usually at the right apex and ranging from old thickened pleural and trabecular scars to old cavities with thick connective tissue walls. These conditions may be accompanied by an outspoken eruption of miliary tubercles or other active process, the evidence of which usually consists in necrosis of pulp and ulceration of bronchial mucosae. Frank tuberculosis of any organ or group of organs, aside from the respiratory tract, can hardly be arranged in any exact order. The genitourinary tract, particularly the epididymis, Fallopian tubes and kidneys, the lymph nodes, especially the cervical, the bones and joints, meninges of the brain, pericardium, peritoneum, adrenals and intestines constitute the most common centres of an active lesion. More rarely the skin, breast and other organs may be more or less extensively involved. In all of these locations the disease varies from

extremely acute fulminating processes to old chronic and often apparently completely healed foci.

As to the pathological characters of the conditions which may be caused by the presence of virulent bacilli of tuberculosis in human tissues, one finds the most protean manifestations of any known disease. It does not require a very extensive experience in pathology to convince one that almost any sort of a lesion may mark the presence of tuberculosis and the tissue pathologist early learns to place no limits on the possibility of its manifestations. Exudative processes, abscesses, acute and chronic, fulminating necrosis, caseous necrosis, rapid fibrosis, granulation tissue and slowly progressive formation of adult connective tissue are examples of pathologic changes which one meets, other than the classical miliary tubercle, so often pictured as the sole fundamental lesion of tuberculosis. For convenience of interpretation I have been accustomed to group these various reactions under five types or headings, determining the place of individual lesions by the analysis of the interaction between the invading parasites and the invaded human host. In this interaction four fundamental factors constitute the variables. Two of these belong to the patient and may be designated as "resistance" and "locality or tissue invaded," respectively. The other two are factors of the bacteria and are indicated by the terms "virulence" and "dosage." These terms as used have a distinct and definite application. By "resistance" is meant not only those defenses of the body such as its protective coverings and eliminating secretions of glands but also the as yet poorly defined property of the body cells and fluids called immunity. While this so called immunity is as yet undefined we employ as measures of its effectiveness, both the power of phagocytosis by tissue cells and leucocytes and the immunological reactions involving precipitins, agglutinins and lysins, properties which reside in tissue cells and fluids in varying degrees of concentration.

The "locality or tissue invaded" constitutes a real factor, although not as important as at first supposed, since it has been shown that the bacilli of tuberculosis may pass through tissues without producing lesions and thus are lodged in more susceptible areas. However, no one would question that, other things being equal, the respiratory tract is a more favorable site for the development of the bacillus of tuburculosis than are, for example, the gastrointestinal tract or the skin. In this connection it is interesting to note that several tissues in the body, notably pancreas, voluntary muscle and thyroid, are almost constantly free from

any evidences of tuberculous involvement. In short there is such a thing as relative tissue immunity as well as relative tissue susceptibility.

"Virulence" in reference to bacteria combines at least two factors; one, ability to live and multiply in a distinctly antagonistic environment, and the other, the function of producing either by metabolic activities during life or by disintegration products after death, a poison, which tends to lower the resistance of the host and to improve the conditions of life for the bacteria. The virulence of parasites is the complement of the resistance of the host: in a sense they are reverse sides of the same shield.

"Dosage" signifies the number of the infecting organisms introduced at any one time and is a very important element in the final production of some lesions. A host may be able with comparatively slight disturbances to destroy, eliminate or render innocuous, perhaps one hundred bacteria or any lesser number, whereas one thousand or more may prove too heavy a load.

We are now prepared to indicate graphically the five types of reaction which occur between tuberculosis bacilli and their human host. Type 1 may be designated by the formula R vs. v, in which R stands for resistance and v for virulence, with the understanding that the location of the bacteria and their dosage may modify materially both factors. In this type conditions are most favorable for the patient or host and least favorable for the invading parasites. These latter are either eliminated, destroyed or rendered comparatively harmless. At the most a slow fibrosis without tubercles or necrosis may develop. Serous membranes, particularly pleura and peritoneum, are favorite locations for this sort of lesion.

In type 2 the formula changes to R vs. V (or R vs. v). Bacteria are more virulent and resistance is decreased. The lesions produced are the hyperplastic types of tuberculosis without necrosis and often without giant cells or even rarely without definite tubercle formation. It is a slow proliferative lesion which is not alone confined to the connective tissues, but gradually destroys the pulp of those organs which may be invaded. Lymph nodes are particularly attacked in this type but the meninges, liver, kidneys and appendix may show the same process.

With type 3, the combat is on more equal terms, resistance and virulence are about on a par and the issue is often decided by purely minor factors which, ordinarily of little moment, are here sufficient to turn the tide toward recovery or defeat. The formula may be expressed by equal

sized letters R vs. V; and the lesions consist of the classical tubercle with necrosis and giant cells and a more or less rapid conglomeration of adjacent areas. While this type is perhaps the most common form of tuberculosis and is found in nearly every tissue of the body, particularly the lungs, it by no means represents a predominating form of lesion and therefore failure to find typical tubercles, a most discouraging experience to the younger pathologist, does not alone justify a negative diagnosis.

In type 4 virulence definitely exceeds resistance and may be graphically expressed by *r* vs. V (or R vs. V). Here necrosis becomes predominant though rapid inflammatory proliferation, lymphocytic infiltration and even tubercles with occasional giant cells are a part of the process. The prominence of the necrosis, the rapidity of the process and the inefficiency of any protective connective tissue zone or capsule are its main features. This type is seen in the adrenal most commonly but also occurs in lymph nodes, lungs, brain, liver, kidneys, etc. Occasionally suppuration supervenes in this form, but most often this is due to the addition of complicating pyogenic bacteria.

When resistance is reduced to a minimum and virulence reaches its highest point, type 5 is found. It can be illustrated by the symbols *r* vs. V. The picture is now marked by practically complete absence of all connective tissue reaction, tubercles or giant cells. Exudates consisting largely of serum and epithelial cells may occur, but aside from this, the fixed tissues rapidly melt away before the advancing tide of toxins, and all protective defences of the body are largely inhibited or overwhelmed. This form of lesion is seen most frequently in so called phthisis florida or galloping consumption, where tuberculous pneumonia rapidly involves large portions of the lung and early leads to necrotic disintegration of the pulp. While recovery is usual in type 1, common in types 2 and 3 and possible in type 4, in this last form (type 5) it is very doubtful if the patient ever survives.

Naturally, during the course of one or more attacks or exacerbations of tuberculosis these types change with the changes in the fundamental factors which underlie them, the picture varying as these essential elements are raised or lowered to different stages of effectiveness. Intermediate stages may also be seen and accurate classification in all cases is not always easy or exact, but in general the types are relatively readily recognized. Some such classification is surely desirable, for we need to more carefully correlate clinical findings, therapeutic efficiency and

the pathologic level reached in the balance of the various forces which may contribute to the final resulting lesion.

The application to the problems of tuberculosis of the facts which may be determined by pathological examination, like the application of pathological data in other medical fields, depends largely upon the breadth of one's scientific training and point of view. Even with the most narrowed sort of a scientific horizon, however, these facts must acquire significance. Exact knowledge of the nature and extent and mode of development of tuberculous processes is a *sine qua non* for proper appreciation of clinical phenomena and for the correct interpretation of therapeutic requirements. In addition we must know how widespread is the disease, the relative proportion of cured or arrested cases to those that are active, and especially the extent of the menace which this disease holds for both the affected individual and the human race as a whole.

Particularly instructive is the observation of the large proportion of cases in which old more or less healed caseous and calcareous lesions are found at the bifurcation of the trachea, with or without an accompanying fibrous pleuritis. This indicates the large part that inhalation plays in the infection of the body by bacilli of tuberculosis. The bacteria appear to lodge on the mucosa in largest numbers or most often at the point where the air currents are deflected to the right or left lung. They are then carried to the nearest lymph node, the function of which seems to be to arrest the progress of the invading parasites. Thus tuberculous infection is most often found registered at this point; and this focus may represent the sole lesion or, more frequently still, the primary lesion. I still do not deny the probability of Ghon's conclusion, that in young children the primary lesion may often be found in the lung pulp. In these cases the air passages are shorter, straighter and the respiratory excursion probably somewhat more active. In spite of such considerations, however, the facts which I have noted are too important to be disregarded.

One more conclusion must be emphasized. We often speak of healed tuberculous lesions. The other day I performed an examination on a woman fifty-seven years of age. She had suffered in childhood from Pott's disease of the spine, which appeared to have become arrested at the age of twelve. For forty-five years she lived without experiencing or revealing any evidences of active tuberculous foci. She finally died of general arteriosclerosis and angina pectoris. The lymph nodes at the bifurcation of her trachea contained calcareous and caseous masses,

while adjoining these were young growing tubercles which had evidently sprung into activity only at a very recent date. This illustration gives a basis for the statement that once infected with tuberculosis the patient can never be positively assured of absolute freedom from its recurrence. It thus well behooves the entire race to live under such safe hygienic conditions that this specific and real menace to its existence may be reduced to its lowest possible terms.

STUDIES ON THE ALBUMIN REACTION IN SPUTUM

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The value of the albumin reaction as a diagnostic aid in tuberculosis has been the subject of considerable controversy in past years. The supporters of the value of this reaction strongly advocated its diagnostic importance while its opponents with equal zeal declared its worthlessness. In all probability its real value lies at some point intermediate between the two extremes.

The credit of first recording observations on the albumin reaction in the sputum is given to Biermer in 1855 by Berkovitz and Rudas (1). He found that albumin was present in the sputum from patients having acute bronchitis, pneumonia or pulmonary edema, but not in the sputum of patients having chronic bronchitis and tuberculosis. They also state that Renk in 1875 found the albumin reaction positive in patients with acute bronchitis, pneumonia and tuberculosis, but negative in chronic bronchitis. Lanz (2) computed the albumin content of the sputum from the nitrogen content as determined by the Kjeldahl method in cases of pyopneumothorax, tuberculosis, and bronchitis. Wanner (3) has severely criticised this procedure, asserting that there are numerous other nitrogen-rich materials in the sputum besides albumin. He confined himself to the search for free albumin by boiling with salt solution and acetic acid, and found albumin in the sputum of tuberculous patients, while there was none or only a trace in the sputum of patients with chronic bronchitis and asthma. Lecaplain (4) found a positive albumin reaction in all forms of active tuberculosis, and he cites Roger as obtaining negative reactions in cases of healed tuberculosis. He and other French writers, basing their observations on a large series of cases, conclude that the albumin reaction of the sputum is of marked importance, that a negative reaction permits the exclusion of tuberculosis, and that a positive reaction indicates a possible tuberculosis and justifies observation of the patient for further evidence of this disease.

Berkovitz and Rudas (1) studied the albumin content of the sputum by both the Kjeldahl and Esbach methods. They found that in tuberculosis the reaction was generally positive, that it was also positive in chronic bronchitis, emphysema and in asthma, that the quantity of albumin varied between two wide extremes, that neither the qualitative nor the quantitative determination of albumin of the sputum gave important diagnostic information and that a negative reaction did not eliminate tuberculosis. Among the British observers, Fullarton (5) reports adversely on the value of the reaction as a diagnostic aid in pulmonary diseases.

On the other hand, Works (6) of this country, working in the Public Health Service, reports favorably on it. He affirms that the test is a practical procedure which gives considerable diagnostic information and that its simplicity as a laboratory method makes it a desirable diagnostic convenience. He found that all patients with active pulmonary tuberculosis gave a positive reaction, while arrested cases of tuberculosis gave either a negative or a faintly positive reaction.

Scott (7), working in the Army Medical Museum, is less enthusiastic about the reaction. He studied the sputum of eighty-five patients. One of these he cites in detail because it emphasizes the worthlessness of a negative reaction. The patient had tubercle bacilli in his sputum and a pulmonary hemorrhage, yet the albumin reaction was negative or only faintly positive, the faint reaction being easily accounted for by the serum albumin in the blood which was mixed with the sputum. This patient died three weeks after the sputum examinations had been made and at autopsy revealed typical tuberculous lesions. He had a fatal pulmonary tuberculosis, yet furnished a negative reaction the first time and a very doubtful one the second time. Scott further points out certain sources of error in routine albumin reactions of the sputum. For instance, a certain specimen of sputum was received late in the afternoon by him for examination, and the reaction was found to be negative. It was placed in the ice box and in the morning when tested it gave a faint but distinct positive reaction and, on being allowed to stand about six hours at room temperature, it gave a very heavy ring test. Scott concludes that the reaction is of no value in the routine diagnosis of pulmonary tuberculosis. Likewise Lockwood (8), who studied an extensive series of cases, does not believe this reaction of great value. He states that albumin was always present in the sputum of patients with respiratory diseases, and that in tuberculous patients

the amount of albumin seemed to bear no relation to the stage, duration or activity of the disease process and that the reaction had no practical value in the diagnosis of respiratory affections. Gelderbloom (9) sees in the reaction a valuable prognostic aid in that an increase or decrease of the albumin content of the sputum points to an aggravation or improvement of the disease.

Several years ago, one of us undertook the study of the reaction in the sputum of patients with respiratory diseases. Owing to the pressure of other work, the completion of the study has been delayed until recently. The sputums of 200 patients were examined. Patients with tuberculosis were classified into the usual three (National Association classification) stages,—incipient, moderately advanced and far advanced; and the condition of the individual patient was designated as good, fair or poor. The technique of the reaction was as follows: One part of sputum was mixed with one part of 3 per cent acetic acid and the mixture was allowed to stand for a few moments and was then filtered. The clear filtrate was tested by Esbach's method for albumin, using the Esbach albuminometer tube commonly employed in urinalysis.

TABLE 1

The albumin reaction in the sputum of patients with pulmonary tuberculosis

CLASSIFICATION	CONDITION	NUMBER OF PATIENTS	TUBERCLE BACILLI POSITIVE	TUBERCLE BACILLI NEGATIVE	ALBUMIN PRESENT	ALBUMIN ABSENT	AVERAGE AMOUNT OF ALBUMIN IN PERCENTAGE
							per cent
Incipient	Good	42	26	16	39	3	0.5
	Fair	12	10	2	13	0	1.6
	Poor	6	6	0	6	0	1.4
Moderately advanced	Good	13	12	1	12	1	0.4
	Fair	29	26	3	29	0	1.3
	Poor	22	22	0	22	0	1.3
Far advanced	Good	6	3	3	5	1	1.1
	Fair	7	7	0	7	0	0.5
	Poor	28	25	3	26	2	1.1
Unclassified		26			26	0	

Table 1 gives the results of the examination of the sputum of 191 tuberculous patients. Albumin was found positive in the sputums of 57, or 95 per cent, of 60 patients with incipient pulmonary tuberculosis.

It was present in the sputums of 63, or 98.4 per cent, of 64 patients with moderately advanced pulmonary tuberculosis. It was present in 38, or 92.6 per cent, of the sputums of 41 patients with advanced tuberculosis. It was present in the entire 26 unclassified cases of pulmonary tuberculosis, and in the sputums of 96.3 per cent of all the tuberculous patients examined.

TABLE 2

The albumin reaction in the sputum of patients with nontuberculous respiratory diseases

DISEASE	NUMBER OF PATIENTS	ALBUMIN PRESENT	ALBUMIN ABSENT
Chronic bronchitis	6	0	6
Asthma	2	0	2
Lobar pneumonia	1	1	0

TABLE 3

The persistence of albumin in the sputum of tuberculous patients examined on successive days

CLASSIFICATION	PATIENT	CONDITION	DAYS EXAMINED		
			First	Second	Third
			per cent	*per cent*	*per cent*
Incipient	B. H. R.	Good	0.3	0.3	1.2
	L. L.	Fair	1.0	0.8	
Moderately advanced	L. A. P.	Good	0.2	0.5	0.3
	S. B.	Good	0.7	1.5	0.6
	G. C.	Fair	0.2	0.2	0.2
	D. V.	Fair	1.0	0.7	0.6
	C. A.	Good	0.1	0.9	0.5
	S. G.	Good	0.1	0.2	
Far advanced	R. H.	Good	1.2	2.0	1.5
	M. J.	Poor	0.6	0.2	2.0
	F. P.	Poor	0.6	0.4	
	Z. M.	Poor	0.4	0.3	
	S. O. P.	Poor	0.4	0.3	
	B. M.	Poor	1.0	1.2	
	P. M. M.	Poor	1.0	0.4	

Table 2 gives the results of the albumin examinations in the sputums from patients with nontuberculous respiratory diseases. In 6 patients with chronic bronchitis and in 2 with asthma no albumin was found in the sputum. In 1 patient with lobar pneumonia albumin was found.

Observations were made of the albumin reactions of the sputums of tuberculous patients on successive days in order to observe the quanti-

tative variations from day to day. The results are given in table 3. In some of the patients (not tabulated) the study was carried on over a period of a week. The results, however, were much the same as those given for the three successive days and comment will be limited to these observations as tabulated. It is seen that when free albumin is present in the sputum it persists on successive days, although the amount obtained at any one examination may be quite variable from the preceding or succeeding examination.

Observations were made on the amount of albumin in the sputum, before and after artificial pneumothorax had been performed, in the belief that collapse of the lung might have a marked effect on this constituent of the sputum. The results of the examination of three such cases are given although more cases were studied. These three, however,

TABLE 4

The albumin reaction in the sputum before and after artificial pneumothorax

CLASSIFICATION	PATIENT	CONDITION	ALBUMIN	
			Before pneumothorax	After pneumothorax
			per cent	*per cent*
Far advanced	C. A.	Poor	1.0	3.5
	B. C.	Poor	1.2	0.5
	L. J.	Poor	3.0	2.0

are representative and suffice to show that there is no fixed variation in the quantity of albumin before and after the establishment of artificial pneumothorax in advanced cases of pulmonary tuberculosis.

DISCUSSION AND SUMMARY

It would appear almost conclusive from our tables that the albumin reaction is generally positive in all stages of active pulmonary tuberculosis and absent in other chronic respiratory diseases and as such may be regarded as a diagnostic agent in chronic respiratory infections in favor of a diagnosis of tuberculosis. Yet one cannot ignore, among other evidence to the contrary, such a striking case already referred to as that reported by Scott, where a patient died of pulmonary tuberculosis with a sputum giving a negative albumin reaction, with a subsequent faintly positive reaction appearing only several weeks before death.

Free albumin in the sputum is interesting as a pathological entity. No satisfactory explanation of its presence is as yet forthcoming. The presence of albumin in the urine is generally explained on an inflammatory basis. In the urine we have a much simpler substance for analysis than is sputum. Here there is frequently free albumin without the presence of pus cells or bacteria and the formation of the albumin subsequent to the formation of urine may be dispensed with as a complicating factor. Free albumin is eliminated directly into the urine by the kidneys. Oswald (10) explains this phenomenon on the basis that the permeability of the vessels for proteins becomes specially altered in inflammation so that the large molecules of albumin pass through their walls. Numerous other explanations have been given. For the complete literature on this subject, the reader is referred to Wells (11) and Meltzer (12). Regarding, for the moment, sputum as a pulmonary excretion, the presence of albumin may be explained as its being due to direct elimination from the lungs or its being subsequently formed by autolysis of albumin containing substances such as pus cells, desquamated epithelium, bacteria, etc. That albumin may be directly eliminated by the lungs in certain inflammations does not seem unreasonable. The underlying causes for the elimination of albumin from the kidneys in certain inflammations probably hold true for the lungs as well, whether the accepted explanation be altered permeability of the capillary walls, changes in the osmotic pressure, alterations in the blood pressure, etc.

We have to consider further the formation of free albumin from the waste products of the lungs subsequent to their elimination as pus cells, bacteria, desquamated epithelium, fibrin, etc., which are thrown into the bronchioles for elimination from the body. These waste products remain in the bronchioles as excreted foreign material until such time as they are eliminated. In this interim the proteolytic enzymes that are present in all cells and bacteria may cause an autolysis of the cells with the liberation of free albumin.

Thus far in the speculative interpretation of albumin in the sputum there has been no attempt to differentiate the generally accepted findings in tuberculosis as opposed to other chronic inflammations. A study of the literature reveals that the consensus of opinions of most workers in this field is that the albumin reaction is generally negative in other chronic pulmonary infections. Our own observations apparently support this view.

As to the causes in tuberculosis that may be instrumental in the elimination of free albumin in contradistinction to those inflammations which do not, again we can only speculate. The generally accepted view of lowered blood pressure may be a factor, as may also the toxemia, about which so much has been written but which is more difficult to definitely localize. Corper and Sweany (13) have isolated a proteolytic enzyme from the tubercle bacillus, but proteolytic enzymes are also present in those organisms which cause chronic bronchitis. We can only state that up to the present a complete explanation for the presence of albumin in the sputum has not been advanced.

REFERENCES

(1) Berkovitz and Rudas: Berl. klin. Wchnschr., 1913, l, 1752.
(2) Lanz: Deutsch. Arch. f. klin. Med., 1895–6, lvi, 619.
(3) Wanner: Ibid., 1902–3, lxxv, 347.
(4) Lecaplain: Presse med., 1911, xix, 190.
(5) Fullarton: Glasgow Med. J., 1912, lxxviii, 8.
(6) Works: Jour. A. M. A., 1912, lix, 1537.
(7) Scott: Ibid., 1913, lx, 440.
(8) Lockwood: Ibid., 1915, lxiv, 574.
(9) Gelderbloom: Deutsch. med. Wchnschr., 1913, xxxix, 1987.
(10) Oswald: Zeitschr. f. exp. Path., 1910, viii, 226.
(11) Wells: Chemical pathology. W. B. Saunders & Co., Philadelphia, 1918.
(12) Meltzer: Amer. Med., 1904, viii, 19.
(13) Corper and Sweany: Jour. Bact., 1918, iii, 129.

LOCALIZED SPONTANEOUS PYOPNEUMOTHORAX

REPORT OF A CASE WITH ROENTGENOGRAPHS

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Roentgenology, probably more than any other single diagnostic procedure, is responsible for our present knowledge of the subject of spontaneous pneumothorax. Typical cases are easily located by means of physical diagnosis, while in atypical cases, even with the aid of an exploratory needle, the diagnosis is often uncertain until the X-ray plate clears up the situation. In fact, only recently, due to the frequency with which X-rays are being used in chest work, the medical profession has recognized spontaneous pneumothorax as a common complication in pulmonary tuberculosis.

Of the atypical cases, the localized and interlobar type of spontaneous pneumothorax is probably the most difficult one to diagnose as it is easily confused with large cavity formation, and, therefore, numerous cases of this type escape even the most careful observers.

Several articles have appeared in the literature on this subject. Fishberg (1) recognizes the localized type of pneumothorax as a common complication in pulmonary tuberculosis. Barjon (2) speaks of limited or encysted pneumothorax and states that this condition may or may not be interlobar. Sampson, Heise and Brown (3) in their study of 423 consecutive cases admitted to the Trudeau Sanatorium found 50 cases, or 11.8 per cent, with "annular radiographic shadows." They conclude that

> annular shadows, surrounding areas of increased or equal absorption of the ray, occur in patients more likely to be suffering from pulmonary softening, and indicate rupture of the lung. Owing to the presence of adhesions only partial pneumothorax, with or without fluid, results.

When annular shadows occur immediately above the diaphragm, as in the following case, they are of special interest from the standpoint of differential diagnosis.

REPORT OF THE CASE

Case F. M., female, age twenty-seven, office clerk, admitted to the National Jewish Hospital, November 1, 1917. Mother died of tuberculosis. Has had measles, mumps, chicken pox and whooping cough in childhood, herpes zoster in 1912, influenza in 1913. In July, 1915, she suddenly developed a dry cough and later expectoration which contained tubercle bacilli, loss of weight, hoarseness, chills, fever and night sweats.

On admission the physical examination showed involvement of right upper lobe down to 2nd rib anteriorly and 6th vertebral spine posteriorly, with evidence of excavation and considerable fibrous tissue formation. Left lung and rest of right lung apparently negative. Physical findings were verified by X-ray plates. During her first stay in this institution, her temperature ranged from 99° to 100°, and pulse from 100 to 120. She was discharged on April 20, 1919, her condition being unchanged.

The following six months she spent in another sanatorium. During that time she was apparently improving until September, 1919, when a furuncle developed on her chin. The furuncle disappeared in a few days and she felt well for about three or four weeks, when a carbuncle developed on her left cheek. Her temperature, which up to that time had been normal, rose that night to 103°. She had severe chills, night sweats and pain. The carbuncle was opened up the next morning, but the symptoms continued. Four or five days later the carbuncle was incised again and drained, and it healed in a few days. Her temperature came down to 100.4°–101.4°. The pain subsided; but the chills and drenching night sweats continued as before; she had frequent vomiting and was very weak; her cough which increased since she developed her carbuncle became still worse and almost continuous; her expectoration which was yellowish before became white and frothy. She suffered greatly from insomnia. About two weeks after the carbuncle healed she suddenly developed a very severe attack of coughing followed by dyspnea and an extremely sharp cutting pain over the whole of the right side of her chest and reaching at times the lower part of her left side. The pain was constant. After two or three days it gradually subsided and would return to the right lower chest only on coughing. About two weeks later, she was frightened by a cat which made a sudden jump in front of her window, and she suffered another attack of extremely severe pain in her right chest which lasted for twenty-four hours. In the meantime, all the other symptoms which commenced with the onset of the carbuncle increased in intensity.

On November 8, when she was readmitted to this institution, her temperature was 103°, pulse 150, respiration, 36. She complained of severe headache; her face was flushed. She had nausea and vomiting. Her cough was almost constant, causing pain in her right chest. Her expectoration was profuse,

of yellowish-green color and mucopurulent in character. She had night sweats. She passed four ounces of urine during the first twenty-four hours. The next day she had a violent attack of dyspnea lasting fifteen minutes and another one two days later. Two days after admission, it was noticed that her sputum was slightly foul and increased in quantity. The next day it was decidedly foul and changed to grayish-green. Her urine was examined and found negative. The sputum was positive for tubercle bacilli. Hemoglobin was 85 per cent; white blood cells, 17,000.

Physical examination of the chest showed practically the same findings throughout both lungs as during the first admission, with the exception of the right lower portion. This area which had previously been apparently normal showed marked dulness, almost flatness, extending downward to the base from the 5th rib anteriorly and from the 7th dorsal spine posteriorly. Breath sounds and voice transmission were almost absent. The mediastinum was not displaced. Empyema was suspected but no fluid was obtained on attempted aspiration.

Stereoscopic roentgenograms were read on November 13 by Dr. W. Wasson, our visiting radiologist, as follows:

> Cavity formation in upper right with considerable thickening and fibrous change. Inflammatory mottling throughout right lung. Just above the diaphragm on the right side a cavity with a fluid level. Diaphragm high; some pleuritic thickening; no general empyema. Slight bronchial change on left side. Heart and mediastinum negative. Diagnosis of right base,—probably interlobar pneumothorax.

The lesion resembled a cavity, half filled with fluid and with air above it, apparently under high tension for the bronchus lying to the left of it, when compared with the old plate taken during first admission, seemed to be pushed aside about one-half inch toward the left. The cavity appeared to be framed in by two heavy semicircular shadows as if between the two layers of the diaphragmatic pleura.

Fluoroscopy on November 15 confirmed the level line in the cavity to be due to fluid, for it was seen to splash on movement. The diaphragm was found to be movable but with lessened excursion, and was quite distinguishable from the lower border of the fluid.

The condition of the patient was becoming progressively worse. Her temperature and pulse kept rising, dyspnea was more marked, and sputum more foul. She became delirious, and in general the prognosis appeared to be apparently hopeless.

Early in the morning of November 16, she was seized with an unusually severe coughing spell and suddenly raised about four ounces of thick, foul, yellowish pus. Unfortunately, this pus was taken away before it could be examined. Immediately after this she began to feel better, her general con-

dition improved markedly, and from this time on there was a noticeable daily improvement.

The next stereoscopic roentgenogram was taken on November 20. It showed almost complete disappearance of the fluid level and distinct lessened density around the cavity. The cavity itself was smaller. Roentgenograms taken every few days after this showed progressive decrease in size of the cavity. On January 2, 1920, there was no evidence of consolidation, cavity or fluid level, though some evidence remained of moderate pleuritic thickening.

She has been improving ever since. Her temperature has been normal for the last few weeks, and she is now able to take considerable exercise.

DISCUSSION

The diagnosis of acute suppuration in the chest, especially in tuberculosis, is a very difficult matter, particularly when located right above the diaphragm. Such conditions as acute pulmonary abscess, interlobar empyema, or localized pyopneumothorax are often very easily confused because there is nothing characteristic either in the etiology, symptomatology, physical signs, or laboratory findings to distinguish the lesions. The original diagnosis of bronchopneumonia in this case was changed to one of empyema until the X-ray plate indicated a collection of fluid somewhere about the right diaphragm. The possibility of it being a subphrenic abscess could not be ruled out until the fluoroscope showed definitely that the lesion was above the diaphragm. The presence of air under pressure above the fluid level was not even suspected until we saw the X-ray plate, which reasonably eliminated the question of pulmonary abscess and interlobar empyema. The sudden, severe and sharp pain following an attack of very hard coughing is also more characteristic of spontaneous pneumothorax. Whether or not this condition was preceded by pneumonia complicated by pleurisy is hard to tell: possibly it was.

A so called "false pneumothorax" on the right side is likely to give a picture similar to the one described above. Several cases of false pneumothoraces have been reported. Stivelman (4) recently reported such a case with radiograms. The fact that in our case the lesion is distinctly above the diaphragm eliminates the question of it being extrapleural.

The prominent and outstanding feature of this case is the confirmation of the value of routine roentgenological examination of pulmonary conditions for diagnostic purposes. The physical examination of this particular case with known methods of diagnosis, exclusive of X-ray, would

not give the examiner the slightest inkling that such a condition existed as was actually found. Furthermore, in cases that recover from acute pulmonary lesions, we have no other way of seeing the lesion and the various changes except through the medium of X-rays. In our search through the literature, we have been unable to find a series of plates which would demonstrate the various changes in a localized pyopneumothorax from its full develpment until its complete disappearance as plainly as in the one accompanying this article. In fact, this is the main reason why we felt justified in presenting this case.

The authors wish to express their appreciation to Drs. H. J. Corper and Louisa T. Black for their kind coöperation and advice given during the preparation of this paper.

REFERENCES

(1) Fishberg, M.: Localized and interlobar pneumothorax complicating pulmonary tuberculosis. Arch. Int. Med., 1917, xx, 739.
(2) Barjon, F.: Diagnosis of pleuro-pulmonary affections. Translated by James A. Honeij. Yale University Press, New Haven, 1917, p. 70.
(3) Sampson, H. L., Heise, F. H., and Brown, L.: A study of pulmonary and pleural annular radiographic shadows. Amer. Rev. Tuberc., 1919, ii, 664.
(4) Stivelman, B.: False pneumothorax. Jour. A. M. A., 1920, lxxiv, 12.

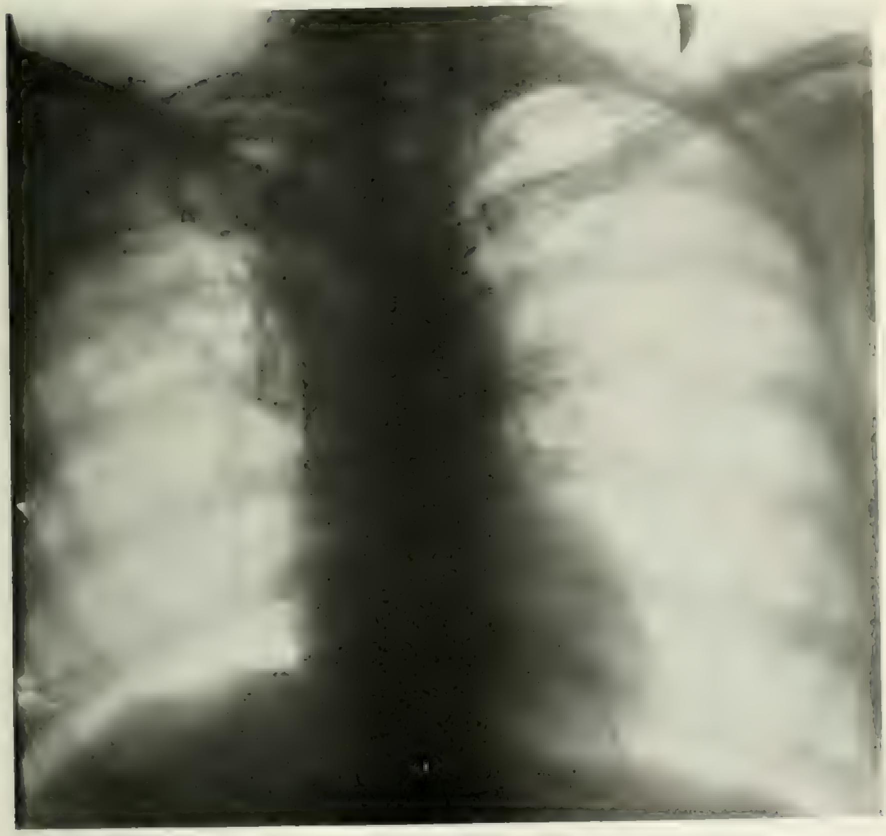

Fig. 1. Plate Taken During First Admission

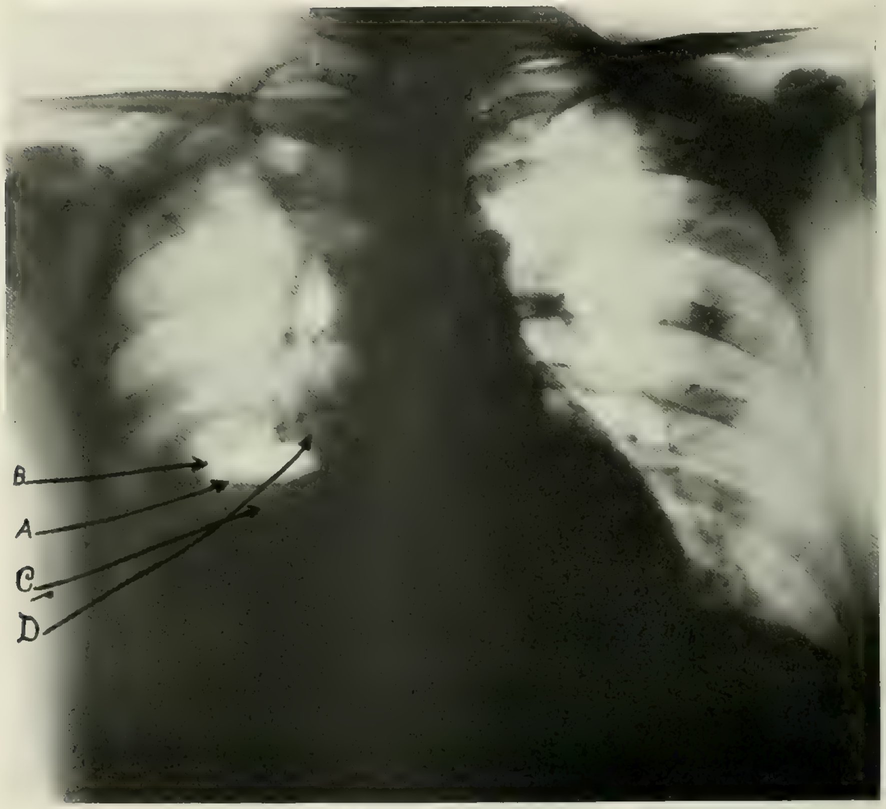

FIG. 2. HIGH DIAPHRAGM ON RIGHT SIDE. CAVITY FORMATION IN UPPER RIGHT. INFLAMMATORY MOTTLING THROUGHOUT RIGHT LUNG

Just above diaphragm on right is a cavity with a fluid level. No general empyema. Some pleuritic thickening. Slight bronchial change on left. Dr. W. W. Wasson's diagnosis: probable interlobar pneumothorax. A. Fluid level. B. Air above fluid level. C. Diaphragm. D. Right bronchus pushed over to left.

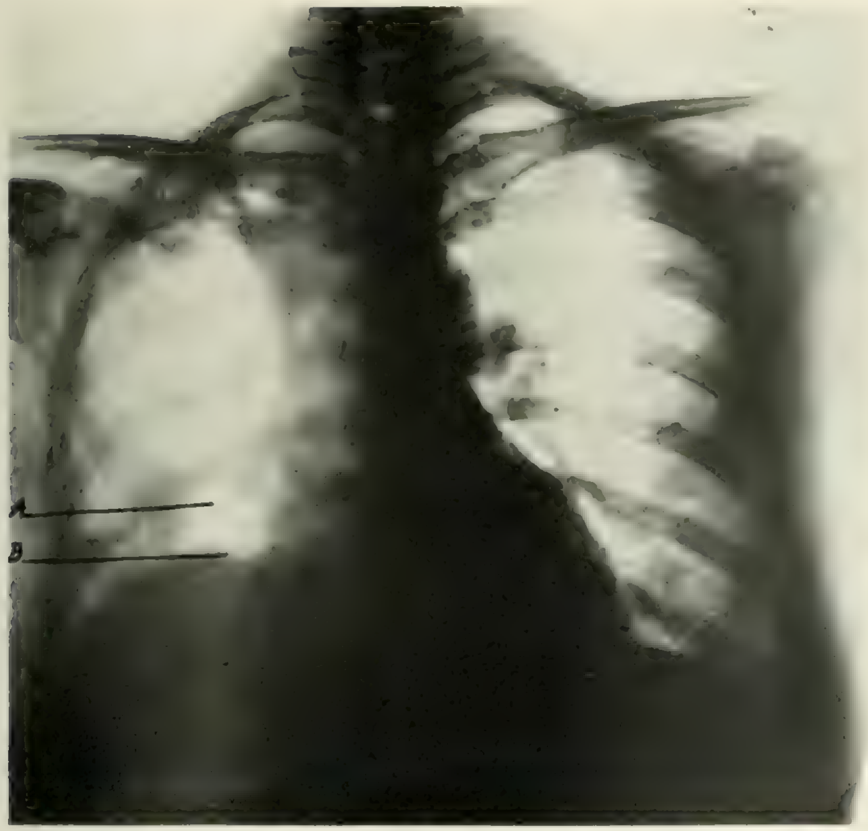

Fig. 3. Shows Disappearance of Fluid Level in Small Cavity Just Above Diaphragm. Lessened Density Around Cavity

A. Air in the cavity. B. Diaphragm

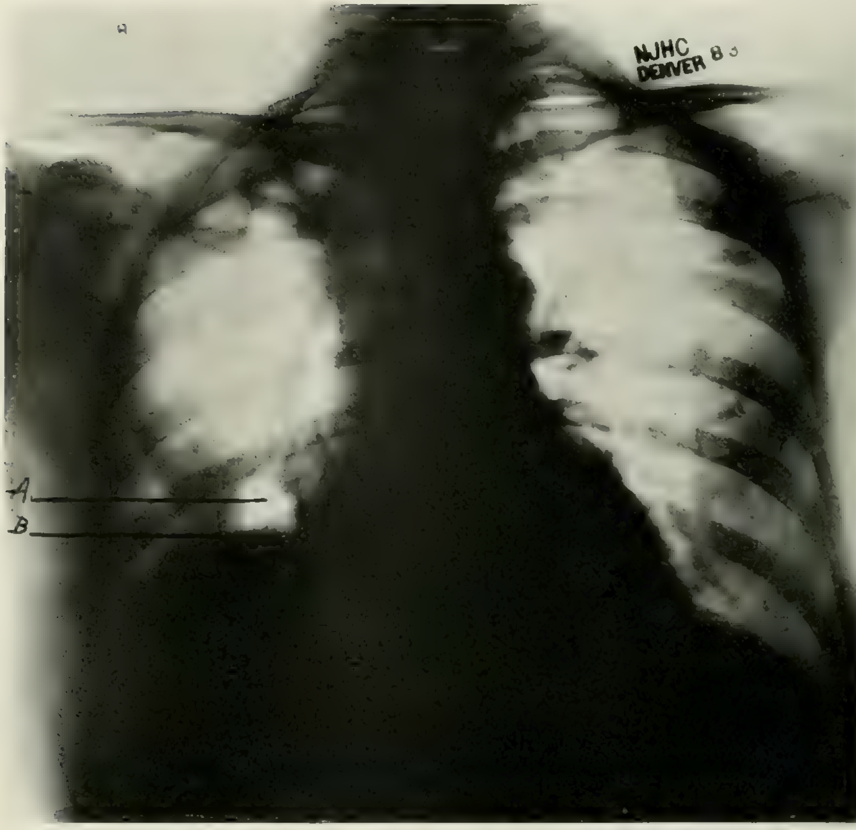

FIG. 4. SHOWS FURTHER COLLAPSE OF CAVITY WITH STILL MORE DIMINISHED DENSITY AROUND THE CAVITY

A. Air in the cavity. B. Diaphragm

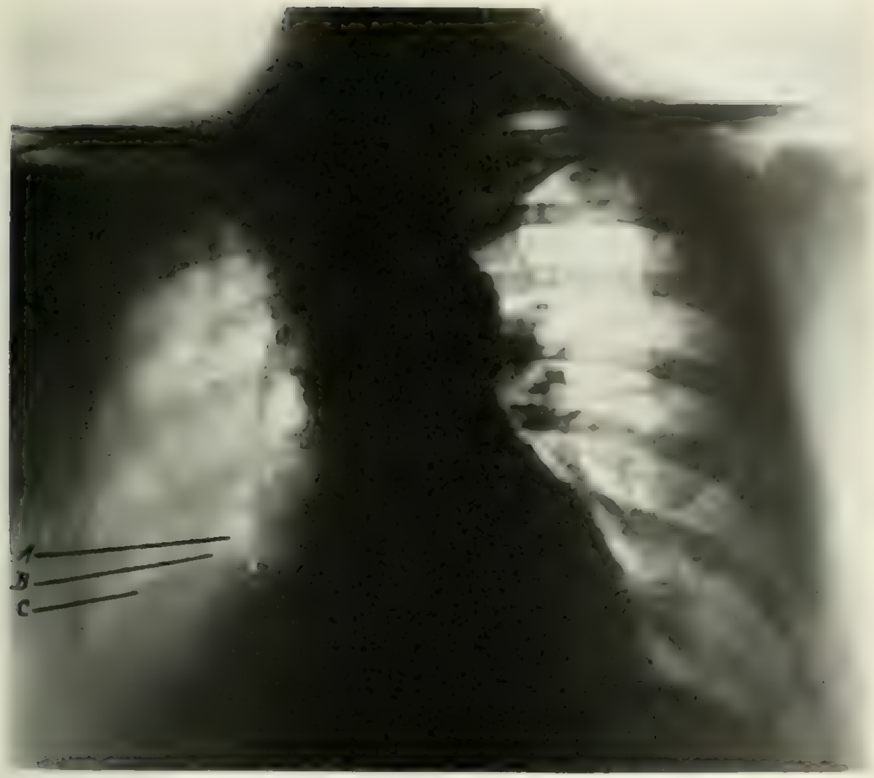

FIG. 5. ALMOST COMPLETE DISAPPEARANCE OF LESION

A. Air in cavity. B. Circumference of cavity. C. Diaphragm

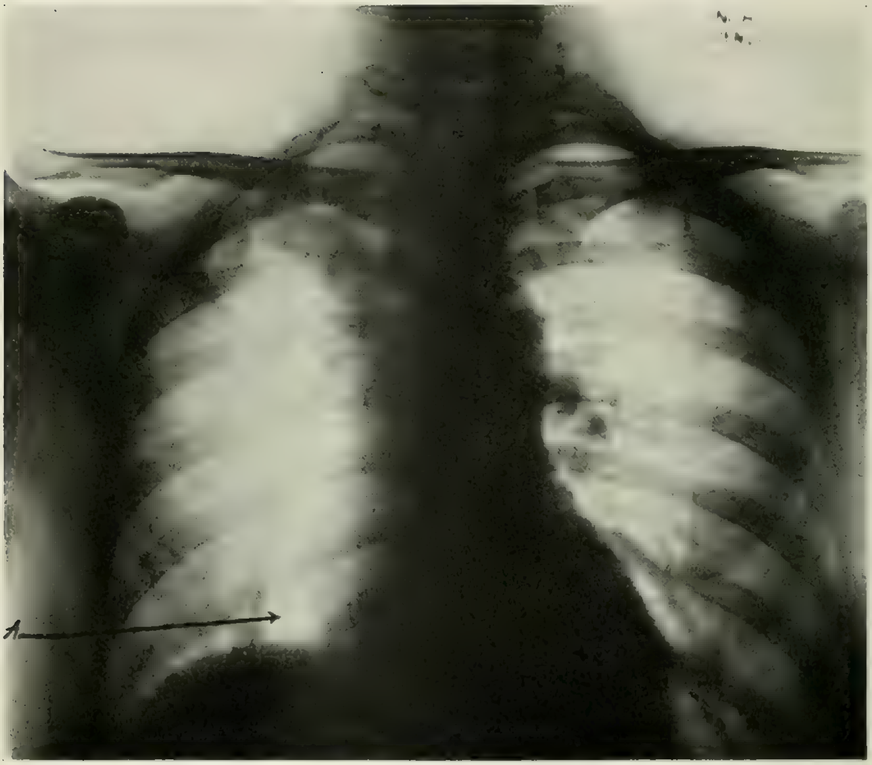

Fig. 6. Cavity Cannot be Made Out. Only Slight Density Remains

A. Site of former cavity

FIG. 7. COMPLETE DISAPPEARANCE OF LESION

FOUR YEARS OF THE FRAMINGHAM DEMONSTRATION[1]

D. B. ARMSTRONG[2]

Tuberculosis is responsible for one in every ten deaths. It is responsible for one in every three deaths among industrial workers. It causes approximately 150,000 deaths annually in the United States, and incapacitates each year from one to two million people. Tuberculosis is, therefore, worthy of serious consideration, from the point of view of community welfare.

This century has been marked by an ever increasing struggle against this cause of unnecessary sickness and premature death. Beginning sporadically, the fight crystallized in the organization of the National Tuberculosis Association in 1904. Since that time, largely under the auspices of this organization, it has extended to all corners of the nation. Concomitant with this development in organization, there has been experienced a decline in the mortality rate from tuberculosis. This drop in mortality is presumably, in part at least, the result of the efforts to control this disease. On the other hand, this effort has involved ever increasing expenditures, so that now the National Tuberculosis Association alone, directly, or through its associated state and local organizations, is expending annually four or five million dollars in the struggle to find, control and eliminate tuberculous disease.

This great expenditure and the extent of organized effort involved inevitably stir up inquiries in the minds of many as to the effectiveness of the program and the attainability of the object. What is the best approach to the control of tuberculosis? Given limited resources, what are the most profitable means for fighting the disease? Upon which phases of the program should emphasis now be laid? What is the next step in tuberculosis work? Are we, in fact, on the right track at all in our efforts to control the disease? Is it possible to prove the relative as well as the absolute worth of our disease-preventing and disease-controlling devices?

[1] Presented in the DeLamar Hygiene Lecture Series, Johns Hopkins University School of Public Health, November, 1920.

[2] Executive Officer, Community Health and Tuberculosis Demonstration.

These questions were undoubtedly prominent in the minds of those responsible for the establishment of the Framingham Community Health and Tuberculosis Demonstration. This experiment or demonstration, beginning approximately on January 1, 1917, and financed by a special gift from the Metropolitan Life Insurance Company to the National Tuberculosis Association, has now been under way for four years. It has not as yet furnished final and complete answers to the above inquiries. Out of the Demonstration have come, however, many important tentative conclusions or suggestive results; and a summary of these findings should be of practical value to those interested in public health and tuberculosis control.

It will be remembered that Framingham, Massachusetts, was chosen for this demonstration because it was a representative American community of approximately 16,000 people, typical in most respects of American industrial, living, and social conditions. There was here also a promise of sufficient local coöperation to justify the success of the practical service aspects of the Demonstration program—an assurance which has been generously substantiated by experience. The objects of the Demonstration were essentially to bring under observation all of the tuberculosis in the community, to apply the best known methods of treatment, to develop a comprehensive program of prevention and to organize most effectively the varied resources of the community for tuberculosis control, disease-prevention and health-creation.

To summarize most briefly the historical aspects of the Demonstration to date, it may be stated that the work has been developed in four theoretically distinct, but practically overlapping, phases:

A. RESEARCH

Fundamental to such a community experiment was a series of investigative activities, whereby, if possible, answers might be secured to certain basic inquiries with reference to the incidence of tuberculous infection, the prevalence of tuberculous disease, the hygienic hazards and resources in the community, etc. It was anticipated that the facts that might be brought out by inquiries thus directed would be essential to the shaping of a practical program for control. The results of the investigative phases of the work have been reported in detail in the mono-

graphs[3] and elsewhere, but only a few of these activities can be enumerated here:

1. A sanitary survey of school and factory conditions, milk and food control, general sanitation, morbidity and mortality statistics, etc.

2. A sickness survey, indicating a sickness rate of 1.8 per cent for incapacitating illness, 6.2 per cent for all forms of illness and 0.24 per cent for tuberculosis.

3. A series of medical examination campaigns, with the routine age-group examinations now covering approximately three-fourths of the population, disclosing an incidence for active tuberculosis of 1 per cent, for arrested tuberculosis of approximately 1 per cent, and a prevalence of illness and disability of all types of 77 per cent, etc.

4. A Pirquet tuberculin survey, disclosing the fact that 33 per cent of the children between the ages of one and seven years covered in the survey gave positive reactions, and indicating significant variations on a race stock basis.

5. A careful investigation of influenza sequellae, with particular reference to the relation of this disease to tuberculosis.

6. A census of all individuals in Framingham, covering matters of hygiene, housing, economic status, etc.

7. A survey of tuberculous infection among cattle supplying milk to Framingham.

B. INITIATION OF PRACTICAL SERVICES

Having made what constituted a community diagnosis as to hygienic conditions, the Demonstration quite logically initiated a series of community treatment measures. For the most part the activities listed under this heading were built from the ground up, those activities already started and subsequently expanded being held for subsequent discussion:

1. The establishment of an expert advisory consultation service, offering consultations to local physicians on difficult or doubtful cases of respiratory disease, thereby increasing the number of cases discovered,

[3] Monograph No. 1, General Series I. The Program.
Monograph No. 2, Medical Series I. The Sickness Census.
Monograph No. 3, Sanitary Series I. Vital Statistics.
Monograph No. 4, Medical Series II. Medical Examination Campaigns.
Monograph No. 5, Medical Series III. Tuberculosis Findings.
Monograph No. 6, Sanitary Series II. Schools and Factories.
Monograph No. 7, General Series II. The Children's Summer Camp.
Monograph No. 8, General Series III. Health Letters.

tripling reporting, improving early diagnosis, increasing the number of cases receiving institutional care, and encouraging the study of early signs of disease.

2. The development of X-ray and other technical and diagnostic procedures, thereby rendering more available to the average physician the so called "instruments of precision."

3. The development of a fresh basis for case classification, operating through a current classification chart, of value in picturing continuously the progress of cases individually and according to significant groups.

4. The development, through the aid of special committees, of a set of diagnostic and therapeutic standards[4] for pulmonary and nonpulmonary tuberculous disease in children and adults.

5. The establishment of a summer camp for children, utilizing abandoned town buildings for this practical service, through which have been provided the advantages of food and personal hygiene to large numbers of undernourished and so called "pretuberculous" children.

6. The establishment of a domestic economy and food hygiene educational method, in coöperation with the State Normal School in Framingham, reaching families selected through the public school medical examination of children, the families of the under-par camp children in the special nutrition class, and the tuberculous families.

C. THE STIMULATION AND TRANSFERENCE OF ACTIVITIES

In addition to the practical services initiated in the community, direct or indirect aid along financial and other lines has been given to many local health services already developed to a greater or less degree in the community, but extensively expanded through the aid of the Demonstration:

1. The promotion of infant welfare work, beginning with a single summer clinic, and now comprising two nurses, four clinics and paid medical service at the clinics—a service covering prenatal, infant, and preschool needs. This organization, first fostered by the Demonstration and then further encouraged by the Framingham Civic League, is now under the auspices of the local Department of Health.

2. School health work, beginning with one nurse and a part-time physician, now including a fulltime physician, or his equivalent in part-

[4] See special Diagnostic Standards Bulletin distributed by Framingham Community Health Station.

time service, a nurse, a dental hygienist, a dental clinic, physical education, posture work, etc.—the whole program now financed by the town and supervised by the local School Committee.

3. Industrial health work, beginning with a single factory clinic and a nurse, and now including one fulltime and several part-time factory physicians, three or four industrial clinics, a staff of nurses, together with other hygienic educational work.

4. Tuberculosis nursing by the Department of Health, now covered by a fulltime nurse, a tuberculosis clinic, with adequate medical service, thereby releasing the nursing staff of the Demonstration for the investigation of arrested cases, influenza follow-up, the study of cervical adenitis cases, research on positive Pirquet children, and other investigative activities.

5. A program of education, including the development of educational and neighborhood committees, Health Crusader and Clean Club work in the public schools, lectures to mothers and industrial groups, health moving picture programs, the promotion of the Red Cross seal sale—all of these activities being carried out now under the direction of the Civic League Tuberculosis Committee and its educational field worker.

D. COÖRDINATION

It will thus be seen that with the development of the Demonstration program, practical services have been handed over to a variety of local agencies, or more fully developed with Demonstration aid under their auspices. This has meant two things: first, the development of all the resources of the community that can be brought to bear upon health and disease problems; and second, the sacrifice, to the principles of local responsibility, permanency of establishment, and a convincing demonstration, of a certain amount of control, and guarantee of efficient service on the experimental side. Consequently, at the present time the list of agencies, public and private, now interested in practical health service in Framingham includes the local Board of Health, the School Committee, the Park Commission, the Framingham Hospital (district nursing and bedside care), the Civic League, the Red Cross (aid in summer camp work), the Normal School, etc. Framingham may perhaps in this stage be likened to a public health wheel, full of health spokes, but at present with no satisfactory local and visible hub. Here remains one of the primary purposes of the Demonstration, still awaiting com-

plete accomplishment, namely, the effective coördination of permanently established local health services. For the accomplishment of this end, as well as the completion of certain of the investigative and medical research aspects of the program, the period of the Demonstration has recently been extended for another three or four years.

Such in brief may be said to be the purpose and history of the Demonstration. While a narrative report and a current account of stock are timely, it is of course too early to talk in terms of final conclusions. As yet there may be said to be no great final *result* of the Demonstration. There are, however, many important "results" in the minds of the committee and staff in charge of the work. It was the conviction as to the importance and promise of the findings thus far that led the National Committee in charge of the work, and the Appraisal Committee[5] which studied the Demonstration recently, to recommend the extension of time referred to above. In the light of the questions as to the validity and direction of present day antituberculosis activities, summarized in an earlier paragraph, what may be said of the Demonstration findings? To what extent do they answer these inquiries?

1. How much tuberculosis is there? The examination of thousands of people in Framingham,—men, women and children,—of various industrial and race groups, indicated that approximately 1 per cent were suffering from tuberculosis in an active form. Another 1 per cent were classified as having arrested tuberculosis. This would mean, therefore, that in a city of 100,000 people there probably are at least 1000 cases of active disease. This, then, is what might be called the first "Framingham yardstick." It is a percentage which has indeed been generally substantiated by examination work elsewhere among civil as well as military groups.

2. How many cases should be under care? When the work started in Framingham there were 27 known cases of tuberculosis under care. There had never been more than 40 known cases at one time in the past, averaging a ratio of known cases to annual deaths of about 3 to 1. An intensive search for cases soon raised this total to several hundred, and the ratio of known active cases to annual deaths was found to be 9 or 10 to 1. Now this would mean in a city of 100,000 people, with 100 deaths a year, or a death rate of 100 per 100,000, that there should

[5] See special Report on Framingham Appraisal Committee, distributed by the Health Station in Framingham.

be under care or observation 900 or 1000 active cases. Does not this answer the question as to what is the next step in tuberculosis work? Does not this "Framingham yardstick" indicate that the "next step" in tuberculosis work is the *first step*, namely, the discovery of the disease? Is it not of relatively little use to provide adequate machinery for the care of one-third of the active cases in the community if the other two-thirds are undetected and unrestrained, or unbenefited by therapeutic control?

3. What machinery is necessary to find tuberculosis cases? When the work started in Framingham, the community was equipped with routine machinery, including a dispensary, a part-time nurse, medical attendants at the clinic, an Antituberculosis Society selling Red Cross seals and doing some educational work. With this machinery, the ratio of cases to deaths was 3 to 1. A sickness survey carried out by nurses and insurance agents disclosed a certain amount of hitherto unknown tuberculosis. Following this survey, a large percentage of the same people as were covered in the canvass was given a thorough medical examination. The examination work disclosed approximately nine times as much tuberculosis as was found by the nurses in their search for the disease. Consequently, it is concluded that *medical* machinery, on an adequate basis, is essential to the discovery of tuberculosis. This is of course no reflection whatever upon the utility of the nurse in the anti-tuberculosis campaign. She is vital to all phases of it; but to expect her to find a full quota of tuberculosis without proper medical aid is placing not too much confidence in, but too much responsibility upon, the tuberculosis nurse.

4. What medical machinery is most useful?

a. Routine medical examinations. The examination of three-fourths of the population of Framingham has of course been a fruitful measure in the discovery of the disease. It is important to use every educational channel to promote the idea of routine, at least annual, thorough medical examinations.

The Framingham experience would also indicate that educational campaigns aimed in this direction will meet with success. In a recent survey of all of the individuals who had had influenza in the first epidemic, it was found, for instance, that 29 per cent had been to their own physicians during the preceding six months for medical advice and a health examination.

b. Routine medical work in schools and factories. The first time the school physician went through the group of 3000 school children, he discovered 11 cases of active tuberculosis and 69 suspects. The routine medical work in the factories has also been helpful in finding cases, 21 per cent of the fatal cases in 1920 having been found by the factory medical clinics.

c. The expert consultation service. This is perhaps the most important single measure developed in Framingham for the discovery of tuberculosis. Growing out of the medical examination work, it has come to be practically a 100 per cent service, being used by nearly all of the physicians in cases of difficult diagnosis. It requires expert training, tact, and sound judgment on the part of the consultant. This service is a triple link, connecting up the patient with early diagnosis, the tuberculous individual with prompt and adequate treatment, and the physician with expert facilities and scientific knowledge. It renders effective the use of diagnostic instruments and encourages the study of disease in its incipient form.

5. *What percentage of cases should be found in an early stage?* Before the Demonstration the Framingham physicians were reporting 45 per cent of their cases in an early stage. Since the beginning of the Demonstration, of all of the cases that have come under observation and treatment, 83 per cent have been found in an early or hopeful stage of the disease.

6. *How many institutional beds are necessary for the treatment of tuberculous disease?* During the Demonstration Framingham has averaged from one to two active cases taking institutional treatment for every annual death in the community. For a city of 100,000, with 100 deaths a year, this would mean that there should be available at least one bed for every annual death, or 100 beds in all.

7. *What percentage of total cases should be given sanatorium or hospital treatment?* At the beginning of the Demonstration 15 per cent of the active cases were receiving institutional care. During the last two years of the Demonstration this number has averaged 33 per cent of the total, and includes early as well as advanced cases, and those cases which may be sent away for only a few months of the year, as well as for a longer time. There should here be recognized the hygienic and educational advantages of even a short term in an institution, as well as the direct therapeutic assets in this form of treatment.

8. *What then constitutes a reasonably complete local community program for tuberculosis control?*

a. Adequate medical machinery for the detection and treatment of the disease, including routine medical examination work in schools and factories, infant stations, and elsewhere. This means at least one full-time physician or his equivalent for every two or three thousand of the school or factory population. It means fundamentally an increase in the organized social use of medical resources.

b. Adequate nursing machinery. This means a sufficient supply of tuberculosis, infant welfare, school, factory, and district nurses, if a system of specialized nursing is employed. If the nursing is on a generalized basis, it means at least one nurse for every 2000 of the population.

c. Adequate institutional provision (*see 6*).

d. An effective educational program (*see 9*).

e. Proper legislative provisions, including the prohibition of spitting, the control or segregation of incorrigible open cases, etc.

f. Satisfactory general sanitation, including a hygienic milk supply.

g. Proper organization, the coördination of devices for disease control, the development of a complete program for all age groups, and the enlistment of all actual or potential resources in the community.

9. *What constitutes a satisfactory educational program?* It must be remembered that out of the average 100 people in a community probably 90 have tuberculous *infection*. Out of this same hundred people, probably 2 have active or arrested tuberculous *disease*. Finally, 10 out of the 100 people are probably eventually going to *die* of tuberculosis. An effective educational program must, therefore, recognize that tuberculosis is a cause of infection, a cause of disease, and a cause of death. To be complete an educational program must recognize all of these approaches. It must:

a. Fight tuberculous *infection*—by the control of open cases, the protection of children and others from massive infection, improved general sanitation, the protection and pasteurization of milk supplies, etc.

b. Fight *disease*—by lessening stress or strain of living and working, by making proper medical and social adjustments for tuberculous individuals, by improving nutrition and personal hygiene.

c. Fight *mortality*—by promoting the use of adequate and properly administered institutional and home facilities for disease treatment.

10. How many cases will escape early detection, even with adequate machinery? It is evident in the Framingham experience thus far that even with reasonably adequate machinery for disease discovery, a certain percentage of cases will escape early detection, and will not come under observation until moderately or far advanced. What is the irreducible minimum for advanced case discovery?

As was stated under heading 5, in the beginning 55 per cent of the cases were discovered in an advanced stage. During the period of the Demonstration this percentage has been reduced to 17 per cent. This study indicated that 3 per cent thus classified should have been discovered in an early stage, if the machinery had been working in all respects effectively. It would seem, therefore, that, so far as the Framingham experience is concerned, one would still expect to have at least 14 per cent of the cases escape early detection. This might, therefore, be stated as the irreducible minimum for the discovery of advanced cases.

11. How many cases will die in spite of adequate treatment? During the four years of the Demonstration, out of the total 356 early and advanced, active and arrested cases under observation, 21 per cent have died. A careful study of these cases indicates that 5 per cent should have been saved, or at least their deaths should have been postponed, with properly operating machinery, and with satisfactory coöperation from the patients themselves. It would therefore seem that in spite of all measures the minimum of 16 per cent would remain as the irreducible standard for mortality, based as this is on the four years' experience and the observation of all of the cases that could be found in a normal American community during that period.

12. What are the etiological factors in tuberculosis? The history of tuberculosis has been to some extent a history of 100 per cent claims as to the cause of the disease, most of which have failed of substantiation. The environmentalists (using the term in its limited sense to mean direct physical surroundings, such as housing, sanitation, etc.) were first in the field, so far as recent tuberculosis history is concerned, claiming the superimportance of this factor in tuberculosis causation. Then came the economists, who stated that tuberculosis was largely a matter of wages and economic condition. We now have those who would emphasize particularly nutrition as a factor in disease, and for some time attention has been called in many quarters to the significance of race stock as an element in the relative incidence of tuberculous disease.

Framingham experience is not of sufficient duration and does not perhaps cover an extensive enough field to justify the appraisal of the relative importance of these and other factors. It has been extremely interesting to observe, in Framingham and elsewhere, that the incidence of both infection and disease varies tremendously with race stock. In the Pirquet survey of children, for instance, whereas 33 per cent of the group as a whole, between the ages of one and seven, showed positive reactions, the positive reactors among Irish and Irish-American children were 30 per cent of the total in this race group, while positive reactors among Italian children constituted 51 per cent. On the other hand, the actual examinations of adults and children have disclosed very nearly ten times as much active tuberculosis among the Irish as among the Italians.

While no final deductions have as yet been made from these findings, it is important, from a practical point of view, to recognize when shaping up a community tuberculosis program that many, various and sometimes antagonistic forces may affect the incidence of tuberculosis in a community, both as an infection and as a disease.

13. What is the cost of a reasonably complete tuberculosis program? The program against tuberculosis is closely interwoven with the general health program. It is therefore impossible, excepting in a most artificial way, to separate the cost of tuberculosis work from the cost of general health work. In Framingham, at the beginning of the Demonstration, the community was spending approximately 40 cents per capita per year on all kinds of health work. The community is now spending about $2.00 per capita per year from public and private funds combined. In a city of 100,000 people this would mean an annual health expenditure of about $200,000.

This amount of money will buy reasonably adequate prenatal, infant, and preschool work; satisfactory school health work; industrial health work; special tuberculosis work along many lines; and general community sanitation. It will cover all of the services detailed in an earlier section of this paper, with the exception of one or two services still being carried in Framingham by the Health Demonstration itself, such as the consultation service—a service which will eventually be provided on a state basis rather than by the community itself.

14. What results may be expected? So far as Framingham is concerned, it is of course too early to talk in terms of final conclusions. The criteria of the success of such a program will include the general health-

fulness of the population at large, a reduction in tuberculosis morbidity and mortality, and increased productiveness and happiness as the result of a greater freedom from disease and a more abundant life.

Tuberculosis as a cause of illness in Framingham is apparently being brought under control. This is particularly true as reflected in the decreasing number of advanced cases. As to mortality, it may be stated that the tuberculosis death rate per hundred thousand, corrected for certification and residence errors, for the decade preceding the Demonstration was 121.5. For the entire Demonstration period thus far, with similar corrections, including the rate for 1920, the figure is 84.2 per hundred thousand—a reduction of about one-third. For 1920 the rate was 64.5 per hundred thousand—a reduction of about one-half under the pre-Demonstration rate after four years of intensive work.

This rate would mean that the same measures if successfully applied to a hundred thousand people, with 100 deaths a year at the start, would save 50 lives a year. For the United States as a whole, this would mean a saving of 75,000 lives annually.

In conclusion, there must be emphasized the necessity for recognizing the comprehensive nature of an effective antituberculosis program. It is essential to employ all of the community's resources. Tuberculosis is not merely a medical problem; it is not merely a health problem; it is a social problem, in the broadest sense, requiring a comprehensive community engineering plan, if the possibilities for disease control are to be realized to the full.

A RÉSUMÉ OF A TUBERCULOSIS SURVEY OF A SILK MILL VILLAGE IN NORTH CAROLINA

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Number of deaths Since the establishment of the silk mill at W——, North Carolina, twenty years before this survey was made (1915), from which time the village dates its existence, there had been 142 deaths from the following causes:

Tuberculosis		92
Typhoid fever	6	
Diarrheal diseases	18	
All other causes	26	50
Total		142

It will be seen that in round numbers two persons died from tuberculosis every time one person died from any other cause. Or we might look at it from the standpoint of the death rate per 100,000. The average death rate from tuberculosis per 100,000 people in the United States is 147. It has been higher than this figure in the last twenty years, and the death rate from tuberculosis is lower than that figure in North Carolina at this time. A total of 407 inhabitants multiplied by twenty years would equal 8140 inhabitants for one year and at a death rate from tuberculosis of 147 per 100,000 would entitle this village to 11.96 deaths from tuberculosis in twenty years. Instead of having approximately 12 deaths from tuberculosis they had 92, which in round numbers is 8 times as many deaths as the average death rate from tuberculosis throughout the United States. But it is known that the population did not average 407 for the twenty years, as there were no people living in the territory occupied by this village when the silk mill was first established. This was the first silk mill to be established in the south, and was considered an experiment, and the few people who worked there lived for a considerable time anywhere in and around the town wherever they could find houses. It would therefore seem proper to assume that the population would not average for the twenty years more than one-

half the present number, in which case they had 16 times as many deaths as the average death rate throughout the United States. Of the 407 population, 350 were white and 57 were colored. There were no deaths among the colored population from tuberculosis. It would not be improper to compute the death rate on the white population alone, in which case the rate would be higher.

Contact infection. A further investigation shows that there are in the village under consideration 99 families, and in round numbers an average of 4 to each family. The 92 cases of tuberculosis have occurred in 25 families. This at first glance would seem to indicate that there were 4 times as many families who had not had a case of tuberculosis as those that had, or a ratio of 4 to 1. But this is not a correct ratio for the reason that we secured the names of every family that had resided in the silk mill village in the twenty years in which there had been a case of tuberculosis. We could not secure the name of every family that had resided in the village during the twenty years, but it is safe to assume that in this time as many families had lived there and moved away as are there at present. In this case there would have been 200 families, only 25 of which had had a case of tuberculosis, or a ratio of 8 to 1. It is entirely probable that the ratio is higher than this. And too, it must not be forgotten that these people worked together in the same mill, attended church and Sunday school together in their village church and were all acquainted with each other and perhaps visited with each other quite generally.

We stated above that the tuberculosis was confined to 25 families, but the records show that it was confined to 15 family trees. A family tree is represented by the diagram accompanying this paper. The history of tuberculosis in this family is of sufficient importance to elaborate. We were unable to find out the cause of death of the husband of the first Mrs. D., nor could we obtain information as to the cause of death of one daughter-in-law. The others are shown in the diagram and the history is as follows:

Mrs. D. had tuberculosis and was the mother of 2 sons. The 2 sons are married and have families. She lived with one son 20 miles northwest of W—— until three months before she died. This son became infected; likewise his 2 boys. When he got too sick to make a living on the farm he moved to W——, so that his boys could support him by working in the silk mill. He and his 2 sons died of tuberculosis. When the above mentioned son moved to W—— Mrs. D. went to M——, 10 miles southeast of W——,

to live with her other son, where she lived three months and died of tuberculosis. This son has a wife, a boy of fifteen, a girl two years old, and another girl 8 months old. In this short space of time the grandmother infected the whole family, unless it was her son who spread the disease. This is the history: The son died of dysentery four weeks after his mother arrived in the home. The two-year-old girl showed clinical symptoms of the disease at the age of six, four years after the grandmother went to live with her, and this continued for nine years and she died at the age of fifteen. The eight-months-old girl did not show any clinical symptoms until at the age of twelve and a half years. She died at the age of fourteen. The fifteen-year-old boy is now positive to the Pirquet test and has definite physical signs in his lungs, but no clinical symptoms and is at work in the mill. This son has died of tuberculosis since the survey. The widow is positive to the Pirquet diagnostic test and has a cough, suggesting clinical tuberculosis. When her husband died she moved to W—— so that her children could support her by working in the silk mill, which the son continues to do. And 6 deaths and 1 case are charged to the silk mill, while in reality they were caused by a fond mother who never saw the mill.

Another family tree shows 13 deaths, 3 active cases and 5 positive to the Pirquet test, a total of 21. Tuberculosis was brought into one of the families, causing 6 deaths, by a mother's son who had lived in another state and who came and visited with his uncle for more than a year, the first one to take it being the boy he chummed and slept with.

In the study we made the Pirquet test on 130 people, of which 70 or 53.8 per cent were positive. Of these 55 lived in or had lived in the same house with a case of tuberculosis; 9 lived next door; and there was no history of exposure obtainable in 6.

Much more evidence could be submitted along this same line would space permit. Let us say in closing the evidence on contact infection in this study that the sum total of the evidence showed that 80 per cent of all cases occurred in the same house with a case, and a large percentage of the remainder occurred next door, while there were no cases in 75 per cent or more of the families.

Does not prove 100 per cent infection. Many students of scientific medicine doubt the statement that practically 100 per cent of the population of the United States is infected with tuberculosis. The statements on this 100 per cent infection were given greater credence because they were backed up by a goodly number of autopsies. But it is well to remember that these autopsies were done on hospital ward patients, and could no more be indicative of the population in general than the deaths from

diarrheal diseases in the slums of New York would be indicative of the deaths from the same diseases on Riverside Drive. So the Pirquet test, showing only 53.8 per cent positives among one-third of the people, in a town where the death rate from tuberculosis for the past twenty years had been 16 times as high as the average for the United States, would indicate that the 100 per cent infection claimed by a few pathologists and echoed by a great many other people at least needs further substantiation before we accept it as proved. It is worthy of note that 45.7

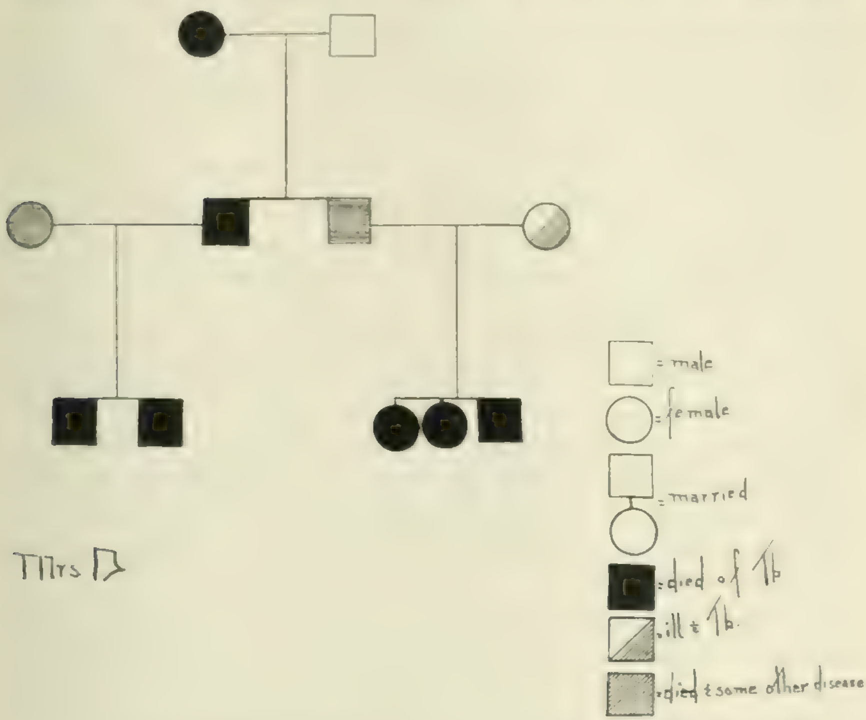

DIAGRAM SHOWING FAMILY TREE OF THE FAMILY OF MRS. D

per cent of those positive to the Pirquet test showed physical findings in the lungs or glands, or both. It is well to state here that the United States Public Health Service found in a study made in the rural districts of Wisconsin that 80 per cent of those living in a house with an open case of tuberculosis were positive to the Pirquet test, 50 per cent of those who lived next door were positive, while of those living farther away only 20 to 30 per cent were positive. Evidently further study on this so called 100 per cent infection is needed.

House infection. It is difficult to convict a house of conveying the infection of tuberculosis from one person to another. In this study it developed that a patient, a male, sick with tuberculosis, lived in a house for more than one year, and that his sister was also ill with the same disease part of this time. The man died two weeks after moving out of the house. The house stood empty for one year, at which time a family of negroes, composed of 2 adults and 6 children, moved in and continued to live in the house to the time of this study, a period of eighteen years. Not one of the family had ever been ill with anything that could be suspected of being tuberculosis, and every member of the family was in good health at this time. No attempt was made to fumigate, disinfect or otherwise cleanse this house. Another house in the village was similarly occupied by 3 persons ill with tuberculosis, all of whom died with the disease in the house. The house remained vacant 1 year and was then occupied by a white family consisting of 2 adults and 3 children, and these continued to live in this house for a period of 17 years up to the time of this study. No effort had been made to fumigate, disinfect or otherwise cleanse this house. No case of tuberculosis had occurred in this family and all were well at the time of this study. This is about the only evidence on house infection noted in this study, and is considered very, very flimsy.

There were many other interesting things developed in thus study; for example, every person had his age, height and weight recorded, from which it would be an easy matter to calculate the state of nutrition in each case examined. The haemoglobin index for each patient examined was recorded.

It was our opinion, from these studies, that the silk mill per se was not responsible for the tuberculosis, but that it was a matter largely if not wholly of contact infection, and that all the original cases developed at some other place and moved into the silk mill village and of course continued to communicate the disease to those with whom they associated most closely, which in most instances were the members of their own family. This information seemed to lull to sleep the conscience of the people of W—— and nothing has been done about the situation so far as we know. While we do not consider that this study has proved anything beyond a reasonable doubt, we do feel that it has contributed valuable testimony on the following points:

1. House infection, that is, the house being the medium of transmitting the infection of tuberculosis from one person to another, is not probable.

2. The infection of tuberculosis is not transmitted by casual exposure, but requires prolonged exposure and massive doses of the tubercle bacillus to produce serious infection.

3. That 100 per cent infection with the tubercle bacillus is a myth, and that the probabilities are that the infection in the South, and particularly in North Carolina, is not likely more than 50 per cent and very probably much lower.

My thanks are due Dr. P. P. McClain, Assistant Superintendent of North Carolina Sanatorium and Chief of Medical Service, Dr. R. McBrayer, Clinician and Director of Laboratories North Carolina Sanatorium, and Miss Grace McCubbins, R. N., who at the time was taking a postgraduate course in tuberculosis nursing at the Sanatorium and is now doing nursing as a missionary in China, for valuable aid in this study.

THE CHILD'S PLACE IN THE TUBERCULOSIS PROGRAM

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In looking backward over the years during which there has been an active campaign for the cure and prevention of tuberculosis we find that although the plan of attack has passed through many phases, it has been advancing constantly in one direction. The objective has ever been to get hold of the patient when he was in the incipient stage of the disease.

Our idea of what incipient disease really is has changed, as our knowledge of the pathology of tuberculosis has increased and our methods and skill in diagnosis have developed. The incipient case of a few years ago was in most patients the counterpart of the moderately advanced type of today. The socalled pretuberculous and doubtful cases of yesterday are now very often unhesitatingly classified as incipient tuberculosis and are given treatment at the most favorable time.

Following this reasoning to its logical conclusion, we should adopt the suggestion made by Brown and Heise in a recent paper, namely; that the cases formerly classified as incipient, that is, those in which the pulmonary lesions are less in extent than those that we now classify as moderately advanced, be called minimal instead of incipient. This acknowledges the existence of a stage of tuberculosis that is intermediate between the really incipient period, which is the glandular type found in childhood, and the moderately advanced pulmonary form, commonly seen in adults and but rarely in childhood. The term minimal disregards the time element, and refers to the extent of the lesion; and therefore better describes the first stage of pulmonary disease. The word incipient implies early or commencing disease without reference to extent, and if confined strictly to its time significance could only be used to describe the earliest manifestations of tuberculosis.

When tubercle bacilli are introduced into the human system they find lodgment in the lymphatic glands where they remain latent for a time. This is the period of infection. The stage of disease begins when these bacilli commence to multiply and form tubercle. This is

the real incipient stage of tuberculosis found very frequently in children but rarely, if ever, in adults. We should look upon tuberculosis when it is confined to the glands as being in its primary stage. When disease extends to the lungs or other organs it is in its secondary stage and is no longer incipient. I would suggest therefore that the term incipient as applied to tuberculosis be used only to mean disease of the lymphatic glands.

As our knowledge has increased in regard to methods of determining infection we realize that in former years we were waiting for the secondary stages to develop before making a diagnosis and instituting treatment.

Furthermore, we should ponder over the fact that although the death rate from tuberculosis in Massachusetts steadily declined from 1885 to 1915, during which time there was a total decrease of more than 50 per cent, it has fluctuated within narrow limits in the years that have since elapsed.

Hospitalization and isolation of patients have been carried out to a great extent, but in spite of this segregation of open cases we find that the Pirquet tests reveal as many positive reactions as in former years. The tuberculin survey made by the Framingham Demonstration in 1917 showed the following positive results in testing 460 children:

ages	*per cent*
1 to 2 years	15
2 to 3 years	25
3 to 4 years	31
4 to 5 years	27
5 to 6 years	52
6 to 7 years	54

The sharp increase in the percentage of reactions in the school age group 5 to 6, 52 per cent, over the 4 to 5 years group, which was 27 per cent, furnishes facts for reflection. It is hard to believe that the exposure to infection is twice as great in the older group. The only noteworthy change in environment of these two age groups is that those between 5 and 6 attended the public school. The inference to be drawn from this fact depends upon whether we look upon a positive Pirquet test as a measure of the resistance of an infected individual or only as an evidence of infection.

To prove that it is only an evidence of infection we must show that the child is subjected to greater exposure to open tuberculosis after

five years old than he was before. And that certainly is not the fact, because in the first place children of the age to attend the first and second grades of school very rarely have open pulmonary tuberculosis; and second, when such is the case these children are usually too ill to attend school. School infection may then be ruled out as an important factor. The opportunities for infection are far greater in the home than elsewhere, both from contact with human tuberculosis and from ingestion of bovine bacilli in the milk.

The death rate from tuberculosis in children under five, is given as 127 per 10,000, while from five to fifteen it drops to 36 per 10,000, and then increases rapidly to its maximum 228 at ages thirty-five to forty-five; another proof that the relative resistance to tuberculosis is at its greatest point during childhood.

If we look upon a positive skin reaction as an evidence of resistance to an existing infection, we can then understand why there is an increasing percentage of positive reactions from the period of infancy through childhood to adolescence. We know from our pathology that tuberculosis is a generalized disease in infancy, and that as the child grows older we have a localization of the infection in the bones and lymphatic glands. Such would not be true if resistance did not increase with the age of the child. It may be, therefore, that the doubling in the number of reactions in the five to six year group may be due to a greatly increased resistance to tuberculosis, which may have been acquired during that age period.

Some valuable information could be obtained on this point if the children that did not react to the Pirquet test in the Framingham group could be kept under observation and given the test every two years until all were eliminated by proving to be reactors or else reach twenty years of age. It might be that some of these children with a known reacting age would subsequently develop pulmonary tuberculosis. We might then obtain data upon which we could base conclusions as to the effect of early infection as compared with later infections on the course of the disease.

It may be that infection acquired between five to ten years of age, when natural resistance to pulmonary tuberculosis seems to be at its highest point, confers more protection on an individual than the primary infection incurred at a later age period. The almost certain fatality for a child found to have open tuberculosis in the years immediately following puberty and the occasional case of socalled galloping consump-

tion in young adults may be on account of late primary infection. The lack of resistance shown in such cases may be due to the absence of protective immunity conferred by childhood infection.

It is probable that the change from the home environment of many of these children to the different atmosphere and surroundings met with in school may really be beneficial. We find at Westfield that the children attending the sanatorium school make better gains in weight and run more normal temperatures than when they are not in school. School hours serve as rest periods from active play and strenuous exercise. Too much play, even in the open air, as well as too long school days, may cause fatigue and lower resistance to disease. A child needs rest, but not too much at one time. A child needs play, but not too long continued. A child needs school, but not too many hours per day. Frequent variations of rest, school and recreation should make up a child's day.

The vigorous antituberculosis campaign that has been waged for many years has been successful in greatly reducing the death rate but this still remains high. The emphasis has been put upon diminishing the opportunities for infection from both human and bovine types, but as yet there is no evidence of any diminution in the number of infected people. We wonder whether it is worth while to continue to concentrate our efforts upon preventing infection from a bacillus that seems to be ubiquitous. It would be unwise, however, in the present state of our knowledge, to relax in any way the well established methods now in use. We should bring our additional reserves to bear upon the problem of increasing the resistance to tuberculosis of the child between the ages of five and fifteen. This is the period when the tuberculosis death rate is at its lowest point. Resistance to infection is then very high and it seems to me that we can accomplish the greatest good by aiding normal metabolism as much as possible at that time in every feasible way. We should strive to build up a strong body by proper food, sufficient sleep and supervised recreation in the open air, so that the tubercle bacilli, which we may take for granted are present, will be buried so deep in fibrous tissue that the ordinary stress of later life may not, by lowering resistance, reactivate and release them.

Fortunately this favorable time is the school period when the public authorities have an opportunity to supervise and direct a child's activities to a greater extent than at any other age in the life of an individual. We have made a beginning, as is shown by the child welfare work and

nutrition classes that are being organized in many cities. This work should be fostered and made so comprehensive that all children attending school are graded each year according to physical standards as they pass through the primary, grammar and high school grades. A thorough examination of each child at the beginning of every school year would be desirable, but until enough school physicians are employed to make this possible the child could be weighed and measured by the teacher and annual records compared. Those who are underweight should have a thorough physical examination to determine if possible the cause of this condition. These physical defectives should then be classified. There will be some with enlarged tonsils and adenoids; others with defective vision or hearing, and others with carious teeth; but after all these easily recognized defects have been corrected there will remain a considerable group that will be found on careful examination to have tuberculous cervical or bronchial glands.

The most common symptom of childhood tuberculosis is fatigue. It may be exhibited in different ways, by nervous irritability or increased restlessness. The child will not want to play games at all or only for short periods. He cannot compete with healthy children either in work or play. He is considered queer by his companions and lazy, languid or inattentive by his teachers. Such children may have occasional febrile attacks which keep them from school for a few days at a time. These ill turns are frequently called colds, malaria, grippe, digestive disturbances or bronchitis. Such are the names under which tuberculosis masquerades in its incipient manifestations.

Furthermore, it must be borne in mind that occasionally children may have glandular tuberculosis and still be normal or above normal in weight. They will, however, exhibit the same symptoms of fatigue and they must be considered physical defectives and treated accordingly.

Cough is not a noticeable symptom in many of these children.

On rare occasions a child will have a strident, paroxysmal cough at night. It resembles whooping cough very much in sound but the excessive mucous secretion is absent. This is a pressure symptom due to enlarged bronchial glands and the reclining posture seems to induce it. Also sudden changes in temperature or violent exercise will produce a paroxysm.

How are we going to set about increasing resistance to tuberculosis in children? I think we should keep in mind the fact that physical development is equally, if not more, important than education because

much learning, gained at the expense of ill health, is of little value to an individual. The school system should be made to fit the child; not the child to fit the system.

Children in the first four grades should not be obliged to go to school more than two and a half hours daily. They will then have an opportunity to spend half the day in recreation in the open air and sunlight. To change to this plan would not require more teachers or more schoolrooms, because the present classes could be divided and one-half go in the morning and one-half in the afternoon. The schoolmaster would doubtless say that it would be impossible to cover all the work that is now required by the public school system in this limited time. I would reply that by leaving out the nonessentials the work can be easily done. At the Westfield State Sanatorium school the children cover all the necessary work of the eight grammar grades in half day sessions and these children are not up to normal in physical condition. Children of the higher grammar grades could attend two sessions daily without harm if they were not given home lessons. With this modification of the public school system the child's mental and physical welfare would be given equal consideration.

Even under present conditions subnormal children should be classified according to their degree of physical disability. This could be done by dividing them into three groups. The first group would contain those who are able to attend two sessions daily. They are only slightly subnormal and their symptoms intermittent. Most of these children need only to have their diet changed and more hours of sleep and rest to come up to normal. The second group would comprise the children who are obviously undernourished. They have occasional days of illness requiring absence from school. They are nervous, restless and inattentive. They have to be pushed along by the teacher to keep up with their classes. Insult is actually added to injury when they are kept after school to do work over or are given home lessons. These children should only attend half day sessions and spend the other half day out doors in rest and play. Their diet should be carefully regulated. Keep in mind that a tired child will not eat. Something more than placing nourishing food before such a child is needed. Rest must precede meal hours in order to develop an appetite. Rest, appetite, food is the sequence to remember in considering the needs of a tuberculous child. It is not always more or better food that is required to make such a child gain in weight. Often it is an additional period of

rest and quiet that is the key to the solution of the problem. The third group exhibit more marked and persistent symptoms of active disease. Some from group two will have to be included because the home conditions cannot be made suitable on account of poverty or stupidity of the parents. These children should go to a sanatorium school where they can have constant supervision and careful regulation of rest and exercise.

Lunches of bread and butter and milk should be provided for all underweight children who attend the morning session because such children are very apt to go to school without much or any breakfast,—not necessarily because food was not provided, but because they have no morning appetite. This is especially true of children with a smouldering tuberculous infection. If a child is not keeping up physically in the two session school he should be sent to the one session school and his program of study modified accordingly. Rest hours at home, more hours of sleep and a change of diet, if need be, would keep more of these children from dropping to the third group, where sanatorium treatment is required.

The methods I have outlined would prevent children from getting too far down in the scale of ill health without the parents or teachers being made aware of it. It is not just to the child to wait until an explosion occurs. Preventive measures should precede curative measures.

School nurses are needed to follow up the children in the home and see that the parents realize that their children are in need of extra care to prevent the development of serious illness and thus obtain their coöperation in carrying out the plans that are recommended.

I firmly believe we can do more to lower the adult death rate by proper care and supervision of the children before the age of fifteen years than we can do by the best recognized treatment after that age period has passed. All of nature's forces which go to build up resistance should be conserved and increased in all possible ways during the developmental period of a child's life.

Then, when adolescence approaches and merges into manhood and womanhood and the call of life's duties and pleasures are at their maximum, the reserve which has been stored up will prove sufficient to meet the demand made upon it.

THE COÖRDINATION OF ANTITUBERCULOSIS AGENCIES

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At the close of the war the period of adjustment following the armistice and demobilization was naturally a time for serious reflection and consideration of what had been accomplished in our fight against tuberculosis during the last thirty years. It was the logical time to take stock as it were, to make a critical analysis of the various methods that had been employed in this campaign and to ascribe to each its practical value and share in the results that have been brought about. Those of us who gave up our work at home to follow some antituberculosis activity abroad were fortunate in obtaining a double perspective and broader view of the situation. Obliged, on the other hand, to make comprehensive surveys of problems to be met, we were naturally forced to consider more critically and carefully the American methods of procedure we were trying to introduce and apply.

Thus, in studying the situation in France, the most striking feature that met us was the lack of a *comprehensive scheme of organization* and the absence of a unified plan of attack. We were struck by the brilliancy and genius displayed in isolated instances, but encountered on many sides a marked tendency to *individualism*. There was no national tuberculosis association or any other national scheme of publicity and education, which could organize a generalized programme. The result had been that so many efforts remained localized. While some of the most epoch making discoveries had had their origin in France, so much so that the introduction of American methods might even seem a presumption, they had never been coördinated with any broad scheme of application. The principal efforts had been directed toward study and research along bacteriological lines, the tubercle bacillus, immunology, and prevention of infection. But, except in a few instances, little attention had been paid to the immense social background of tuberculosis, wherein are grouped the many interacting and correlated predisposing factors that play the more important part in the development or evolution of clinical active tuberculosis.

Reflecting back from our experience abroad, it was only natural, once we were ready to resume our work at home, that we should search more carefully our own methods and be more awake to the defects and faults of our own campaign against tuberculosis. In this spirit of self criticism we found that, to a certain extent, some of the faults that we had found abroad existed also in our own country. It has come to be accepted by many that we too have spent too much energy along the lines of infection instead of paying more attention to the predisposing factors, such as sanitary conditions of homes, factories and schools, personal hygiene and the many social errors that lie at the bottom of the whole question; the real causes that bring about the development of manifest tuberculosis as distinguished from simple infection.

The other point that has been brought out by this study is the fact that in the campaign against tuberculosis we have been seriously handicapped by the lack of more active and more general coöperation on the part of the practising physician, particularly the general practitioner in the rural portions of our country. The details in this connection will be brought out more fully below, after we shall have considered certain general aspects of the tuberculosis problem.

It is not in place here, nor is it the purpose of this paper to enter into any academic discussion of such questions as *immunity through infection* or *superinfection in the adult.* It may be safer not to take too extreme a view or to assume that any immunity that has been acquired by infection is absolute. Massive infection should always be guarded against, especially in young people. Because we vaccinate successfully against smallpox and typhoid fever, we do not necessarily abrogate former precautions as to quarantine or protection of water supply. Prevention of infection would undoubtedly be the ideal to strive for; and simply because it seems impossible to realize, while on the other hand we can bring about practical results by diminishing or ameliorating the predisposing factors, it would seem wiser, in our general propaganda at least, to modify the information given out to the public, in order to allay phthisiophobia which was developed to such an extent as to obstruct the very measures that would make for greater safety and protection of the community.

One point that should be brought out and emphasized repeatedly, however, is the fact that exacerbations of chronic tuberculosis which we meet with clinically are not the result of recent infection but represent only one episode in the long course of tuberculosis infection in that

particular individual. The correct conception of this fact has a very important bearing upon our attitude toward the tuberculosis problem. If, in a given case, for example, there is a history of occasional exposure to infection, one year or six months ago, and the patient on examination presents the physical signs of a chronic fibrocaseous process obviously of years standing, it may be very consoling to a relative to be able to say definitely, that such recent exposure was not the source of the disease. Many cases of supposed conjugal infection are probably the result either of coincidence or living under the same, unfavorable environment. It is certainly difficult to prove the fact of infection in these cases.

In the prevention of tuberculosis we must seek out and remove the factors that lie in environment. We must search for and discover the individual before the disease becomes manifest. We talk glibly about removing an advanced, open case of tuberculosis from the home in order to protect the rest of the family from infection, when the condition has probably existed for some years, and all the members of the family have been infected long ago. The proper time to prevent infection would have been before the disease had become active and the case an open one. Under such circumstances the most efficacious plan of prevention would be to build up the resistance of the children in such a family, in order to prevent infection which presumably has taken place from developing into active clinical disease. It will be a more profitable investment to see that such children have a healthier environment, that they are better housed, that they are better fed, that their resistance is not further impaired by physical defects, that their immunity is not undermined by long hours in poorly built and badly ventilated school houses, that they are protected after they leave school and begin to seek a livelihood by a proper inspection and control of factory and labor conditions. It is along such lines that our educational and awakening propaganda should be directed. We have devoted too much time on the tubercle bacillus itself, when we could expend our efforts more profitably by making the soil unfavorable and thus rendering the germ harmless. This must not be interpreted as deprecating the research work of the laboratory. Its contributions have been invaluable and the search for a remedy for tuberculosis has been the incentive to some of the greatest discoveries in immunology. But for the purpose of popular education and as a basis for a social campaign against tuberculosis, we shall accomplish more if we accept the ubiquity of the tubercle bacillus,

if we acknowledge the hypothesis of childhood infection and the latency of tuberculosis; if we start out in our attack with the assumption that the average adult of civilization is relatively immune against external superinfection, as a result of that childhood infection, and that our efforts toward prophylaxis, as well as those of treatment, must be based upon the hygienic principles that will bring about the greatest resistance, the greatest degree of immunity and the maximum antibody production.

Taking up the tuberculosis problem of Virginia we find that it is a fairly formidable one, not only because of the number of cases existing, which can only be approximated on the basis of the mortality figures, but also for the reason that it is so largely a rural problem and therefore presents a number of difficulties. There is furthermore the factor of tuberculosis of the colored population which in itself constitutes a matter for serious study and contemplation. It has been difficult to make a very satisfactory study of the mortality statistics for the reason that Virginia was not added to the registration area until 1912. For that reason a very exact determination of the various curves for urban and rural or for white and colored is not feasible. Nor is it possible with the figures at our disposal to make accurate curves for the differential tuberculosis mortality, and show the variations of the different forms of tuberculosis. However, the curves for the last five years, showing an annual number of deaths averaging more than 3000, would make it safe to assume that there are at least 18,000 open active cases of tuberculosis, with an additional 18,000 less advanced but active cases, at any one time.

There are at the present time 400 beds for white patients and only 100 beds for colored patients in the State Sanatoriums, with probably less than 100 additional beds for indigent or semi-indigent patients in all other institutions in the state. For the greater number of existing cases therefore there are no facilities for institutional treatment. But even if such facilities did exist it is safe to assume that most of the beds would remain vacant unless other coördinated agencies were to be established in order to bring these patients in touch with such institutions. The sanatorium operating alone as an isolated agency would fail to reach most of them. However, there are probably not more than four tuberculosis dispensaries existing at the present time, all located in the larger cities. No permanent tuberculosis dispensaries have been established for the rural population, although an attempt to establish them has been made in one county.

There is obviously great need therefore for more extensive organization and better machinery in order to search out and discover the greater number of patients, many of whom are unaware of their condition, not taking any treatment, or observing no precautions toward preventing the further development of their malady. In order to bring them under control for purposes of education as much as for treatment, there is urgent demand for a comprehensive system of dispensaries which must however be permanent institutions. There must be an adequate staff of public health visiting nurses operating from the dispensaries, to reach the most remote mountain settlements and to bring the patients to the dispensaries for examination and diagnosis each regular clinic day. Such dispensaries should work with the local practising physicians and provide the services of a fulltime tuberculosis specialist, who shall act in a consulting capacity, coöperating with the local physicians, but not undertaking to prescribe for or treat any patients, unless these are too poor to pay a private physician, or only if requested by the family physician.

In suitable cases the dispensary consulting physician should recommend institutional treatment through the family physician but should not refer patients directly for admission. For the rural communities it would be sufficient to hold such dispensary sessions once in two weeks, the personnel being furnished by or through a central dispensary located in the principal city of the county. The intervals between dispensary sessions should be used by the nurses for instructive follow up work and individual education and demonstration. Special diagnostic features such as X-ray, laryngeal, and other special examinations could be provided at the central dispensary to which patients from the rural dispensary would be referred. The central dispensary might well be connected with a local hospital.

These dispensaries should also be in very close relation to the sanatorium, and patients should be referred back to them after discharge, in order that they may be followed up by the visiting nurse to see that they continue to carry out the instructions they may have received and in this way help to insure a greater permanency of benefit. Such a system would help in selecting the cases suitable for sanatorium treatment, and promote the efficiency and usefulness of the institutions considerably, by preventing recurrence after discharge. For to repeat once more, the acute exacerbations of chronic tuberculosis are only single episodes in the life history of tuberculous infection of the individual

and permanent arrest can only be secured or attained by careful observation and supervision over a much longer period than most patients can be induced to remain at a sanatorium.

Left to itself as an isolated unit without any correlated agencies, the sanatorium sacrifices much of its usefulness in the general campaign against tuberculosis, because it would fail to reach any but a small number afflicted; while the care of the patient after the sanatorium has come to be a much discussed and serious problem.

Finally, as the tuberculosis problem is so intimately related to all other public health problems, its various agencies should be in relation with all existing public health agencies in a given community. The tuberculosis dispensary might with advantage be linked up directly with a diagnostic or health center and in this way work hand in hand with child welfare, infant hygiene, life extension, school inspection, housing commission, factory control, sanitation and all other public health agencies. But all these agencies will fail to attain the maximum degree of efficiency unless they have the hearty interest and coöperation of the practising physician. This question requires fuller consideration.

There are two important reasons why, in connection with tuberculosis work especially, we have hitherto failed to obtain the necessary coöperation of the private physician. One of these is that there has been a lack of instruction and training in tuberculosis at our medical schools and the second reason is that in many instances tuberculosis work, as well as many other social activities, have been initiated by laymen without taking the physician into their confidence. Taking up the first point, the lack of proper knowledge of tuberculosis, it is obviously not through any fault of the doctor, if he has only a hazy idea of tuberculosis. This subject has been seriously neglected in our colleges and hospitals. There are few schools that require systematic special instruction in tuberculosis. Furthermore, since the infectious nature of tuberculosis has been established, patients suffering from this disease have been banished from the general hospital, where they could be studied in correlation with other diseases of the chest and where autopsy findings could be compared with the physical signs, X-ray findings and clinical symptoms. Strong pleas have been made recently in favor of a separate ward or small pavilion in connection with general hospitals, to provide a limited number of tuberculosis patients for teaching purposes.

There is the greatest need for thorough undergraduate instruction in this subject, in order that our coming physicians may understand tuber-

culosis in its broadest clinical, biological and sociological aspects. It is not sufficient merely to make a physical examination and discover the ultimate râle. What is required is the ability from the history, clinical symptoms and physical signs to reconstruct the whole history of the disease in the given individual, in order to decide what were the causes and factors that brought about the evolution of active tuberculosis; then knowing all these facts, including a knowledge of the financial, domestic, and social condition, to decide what is to be the best way of treating him and what are the prospects of his getting well.

Considering finally the coöperation of the practising physician, it should be emphasized again that no plan of antituberculosis organization that does not include him in its plan and scope can hope to attain the fullest degree of usefulness. It is a very just criticism of many social and philanthropic efforts, initiated by laymen from the highest humanitarian and most unselfish motives, that they have not taken the practising doctor into their confidence and made him a partner of their activities. Particularly in the rural districts the family physician exercises a great influence over his patients throughout his community, and could be the first to direct them toward the nearest tuberculosis agency available. He should be made acquainted with the location and scope of such agencies and know the most direct method, by which he can avail himself of their help. He should remain in intimate relation with their operations.

It must be considered, furthermore, that the private practitioner has an inalienable right to earn a livelihood by practising his profession. Neither public or private efforts at bettering community health should interfere with this privilege, which has been granted him by the state on the basis of certain educational requirements. These represent capital invested. The public agency should not seek to divert his patients, prescribe for or treat them, unless they actually require such help as he cannot give them. It should sustain the doctor, as far as consistent with the interests of his patients. The public health agency may help him in confirming a diagnosis that he might be reluctant to make, in view of the still existing feeling and sentiment against tuberculosis as a social stigma. It may also help him by placing at his disposal special knowledge and facilities in the way of laboratory and X-ray examinations, for example. In return, it is only fair that he should extend his aid in the fight against tuberculosis, and more especially, by reporting suspected or definite cases, help in locating the centre of infection.

Operating in this way his prestige will not suffer, nor will he incur material loss. On the contrary, a greater interest in, and knowledge of, health matters in his community will only increase his influence and scope and be to his own practical advantage, provided he is sufficiently progressive to take advantage of such facilities and wide awake to follow the newer trend and development in the field of medicine. The time may come when we shall adopt the oriental system of paying doctors to prevent disease and when all physicians will be fulltime men paid by the community or the state. But until that time comes, we must enlist the private doctor as an important and valuable ally in our plan of campaign against tuberculosis.

EDITORIAL

AGAIN INFLUENZA AND TUBERCULOSIS: A LETTER FROM DOCTOR FISHBERG

When the epidemic of influenza first broke out during the second half of 1918, I noted that my tuberculous patients either escaped the acute disease or, when contracting it, presented milder symptoms, and recovered in larger numbers than those who had not suffered from phthisis. Revising at that time my book on tuberculosis I ventured to record this fact. On November 18, 1919, I presented a communication to the New York Academy of Medicine showing that all over the world experience had shown, contrary to the accepted dictum, that influenza has no etiological relation to tuberculosis, and is not to be considered as a reactivator of latent tuberculous lesions.

Ever since then hundreds of papers have been published both here and abroad on the subject of influenza and tuberculosis. The vast majority agree with the views I expressed in the above mentioned communication. Very few still cling to the old notion that influenza is deadly to tuberculous patients, and that a large number of healthy persons have developed phthisis soon after the symptoms of the acute epidemic disease had abated. Many correspondents have inquired what I now have to say, after it has been shown by some that my views are not in accordance with facts.

The main contentions against my views may be summarized in the following two propositions: (1) A large proportion of patients who have developed phthisis during the past three years mention that they had felt well until an attack of influenza, which was sooner or later followed by the symptoms of phthisis. (2) A large proportion of patients with mild or quiescent tuberculous lesions, and who had good chances of getting well, succumbed to the complicating influenzal process, or soon thereafter to acutely progressive tuberculous disease.

The facts which will clear these problems up once and for all are now available.

It has been estimated that between 20 and 25 per cent of the population of this country has been attacked by influenza during 1918–1920.

In persons between fifteen and forty-five years of age, the period when phthisis is most common, the percentage was even higher. Under the circumstances it is to be expected that, of those who develop active pulmonary tuberculosis during these three years, about 20 to 30 per cent should have had influenza. It is also clear that unless more than 25 per cent of tuberculous patients give a history of having had influenza, we cannot accept the statistics published by several writers as proving that it was influenza that caused the lung lesions or reactivated them.

If influenza had been instrumental in reactivating dormant tuberculous disease, the morbidity would have increased during 1919–1920: the sanatoriums would have been filled. While we have no reliable statistical evidence as to morbidity, we have another means of estimating it. We remember the long waiting lists of the municipal and state sanatoriums in the recent past. What are the facts now? None of the sanatoriums in New York State are filled. In fact, in many there are numerous vacant beds which cannot be filled. Information I have obtained tends to show that this is also a fact in other states. And when we find that the sanatoriums are not filled we may safely conclude that the morbidity from tuberculosis has declined. The explanation offered by some, that economic conditions are responsible, is unsatisfactory for obvious reasons.

Nor has the mortality from tuberculosis increased during the past three years. Dr. Charles L. Minor, while discussing my above mentioned paper made the prediction that "Judging from my experience I believe that the statistics of the next few years will show that this epidemic will result in a very marked increase in the morbidity and the mortality curves from tuberculosis throughout the country." We have just shown that this is not substantiated by the data on morbidity. But the mortality also has decreased. In New York City, for instance, there were reported 7395 deaths from pulmonary tuberculosis during 1919, and only 6164 during 1920,—a decrease of 1231. Similar statistics are available in other cities and those who are interested may easily obtain them from the Health Departments.

We are thus again safe in concluding that influenza has no etiological relation to tuberculosis.

MAURICE FISHBERG.

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The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page.

Social Importance of Early Diagnosis.—One of the great principles in the fight against the spread of tuberculosis consists in the rigorous supervision of confirmed tuberculous individuals and of those who have been in immediate contact with them and are potential spreaders of the disease themselves. The manifestation of the disease in adults may arise a) out of a lowering of body resistance from various causes, giving the bacilli present in the organism a chance to develop; or b) out of a reinfection, which may be one massive entrance of bacilli or successive reinoculation with small doses. Another principle of combat against the disease, therefore, is to preserve the health of children by all hygienic means and to keep up the resistance of adults and keep them from possible infection. Education of the public in elementary hygiene and in the means by which tuberculosis is preventable is an important part of the whole fight. The starting point of the problem is early diagnosis. It is, however, more important to know whether a case of tuberculosis is active, and hence contagious, than to know whether it is an incipient or an old case. It follows that the examination of the sputum of a tuberculous or one suspected of the disease is as important from a prophylactic standpoint as auscultation, percussion, temperature, and all the other means employed in order to make the diagnosis.—*Le diagnostic précoce de la tuberculose et son importance au point de vue social, E. Sergent, Progr. Méd., May 17, 1919, No. 20, 189.*

Tuberculosis Suspects.—Roubier reviews his experience with his last series of 1000 tuberculosis suspects. With an actual tuberculous lesion at the apex, the clinical and the roentgen findings harmonized in 90 per cent but the roentgen rays always revealed more extensive lesions than would be surmised otherwise. In some of the others, bronchitis masked the pulmonary lesion but there were four men with no moist râles, no symptoms of condensation and no crepitation after coughing, and repeated examination failed to reveal any physical signs of a tuberculous lesion, but the roentgen rays showed extensive infiltration and tubercle bacilli were found in the sputum. Atypical cases of this kind formed 4.5 per cent of the men with positive sputum, and they impose the necessity for raying all suspects even when daily percussion and auscultation give negative findings. In five other cases roentgenoscopy showed persistently normal findings, but tubercle bacilli were found in the sputum in some of them after expectoration had been induced with iodide. Rist declares that when nothing abnormal can be seen on the screen or roentgenogram, the lung is

unquestionably normal. Roubier adds that in these cases he had to content himself with roentgenoscopy alone; it is possible that in an instantaneous roentgenogram something abnormal might have been detected. In 1.6 per cent of the cases with positive sputum, both clinical and radiologic findings were so slight as to be only dubiously perceptible. He discusses further the cases with lesions at the base or middle of the lung, and the 307 with chronic bronchitis or permanent impediment to breathing through the nose which had caused the mistaken diagnosis of tuberculosis. This group included further seventeen cases with syphilitic or malignant lesions in the lung or an abcess or interlobar empyema, or else the men (201 cases) were merely narrow chested and suffering from exhaustion, dyspepsia or heart disease. Thus in over 50 per cent of the 1000 men the suspicion of tuberculosis proved to be unfounded.—*Quelques considérations sur la comparaison des résultats des examens cliniques, radioscopiques et bacteriologiques des crachats chez les militaires suspects de la tuberculose, C. Roubier, Progr. Med., June 14, 1919, xxxiv, No. 24, 229.*

Posture a Factor in Apical Tuberculosis.—The orthograde posture determines the apex of the lungs as the site of predilection of incipient pulmonary tuberculosis. This is due to the diminished flow of blood through the upper portion of the lung in the erect posture, and may also be due to the effects of this change on the endothelial cells lining the capillaries. The lack of blood in these capillaries causes a collapse of their walls, thus offering a chance for foreign particles and bacilli to lodge there. That the upper portion of the lung can, at times, be devoid of blood can be understood when we remember that the capacity of the lungs is more than double that needed to convey the blood usually flowing through them. It is possible, therefore, to have that portion of the lung below the entrance of the pulmonary vein engorged with blood while the upper portion is almost bloodless. The absence of a blood stream through these vessels may so injure their endothelial lining, either through the absence of oxygen, or through the presence in excessive amounts of carbon dioxide due to lack of oxygenation, as to render that area a favorable site for the lodgment, growth, and multiplication of the tubercle bacillus. This theory is supported by the known fact that animals subject to pulmonary tuberculosis show the highest portion of their lungs to be the point of predilection of the disease. This at the same time serves to disprove the theory that lack of mobility of the apex is the cause of apical involvement, for in the case of animals the caudal lobes, which show a marked predisposition to the disease, are the most mobile portions of the lungs. Posture will also explain the improvement in early active tuberculosis which follows rest in the recumbent position. Exercise in the chronic forms of tuberculosis is also beneficial by helping to drive more blood through the involved upper portions of the lung.—*Apical Tuberculosis and the Orthograde Posture, W. F. R. Phillips, Med. Rec., August 16, 1919, xcvi, No. 7, 265.*

The Complement Deviation in Diagnosis.—The technique of the test is in fundamental particulars identical with that of the Wassermann. The tubercle antigen employed is essentially the bodies of the tubercle bacilli after their fatty substance has been removed. The process of extracting the fat is that used by Wang in studying the antigenic effect of lipoids in vivo. The syphilitic antigen is an alcoholic extract of the human heart with or without cholesterin. The extract should be allowed to float on the saline for 10 minutes before being mixed. The patient's blood is collected as for the Wassermann test from an arm vein; and the serum heated to 55 to 56°C. for two hours. Or, sufficient blood for the test may be obtained from a prick in the thumb, and the serum inactivated in the same way. Where the drop method is used, the fluid for test is measured in drops from a vertically held weight fitted with a teat at a uniform rate and pressure, the technique being similar to Donald's drop method for the Wassermann. The blood suspension is prepared from defibrinated ox blood; for use a 1 per cent suspension is made up, sensitized at room temperature with 8 to 9 minimum hemolytic doses of amboceptor. The complement is that of guinea pig serum from four to eight hours old. A negative serum is indicated by a complete hemolysis in the tube containing the tubercle antigen. A positive serum is denoted where hemolysis is complete in the control tubes and absent or only partial in the tubercle antigen tube. A strong positive is indicated by +++; a moderately strong positive by ++; a weak positive by +; a doubtful positive by ?. Where there is absence of hemolysis in the tube containing syphilitic antigen as well as in the tube containing the tubercle antigen, the serum should be further tested. For this purpose the suspected serum is mixed with an equal part of saline, and to each centimetre of the mixture two or three drops

of chloroform added; the tube is vigorously shaken for ten to fifteen seconds, and placed in a water bath at 55° to 56°C. for fifteen minutes; the supernatant fluid is drawn off, and the test repeated. Where less hemolysis is observed in the tubercle antigen tube than in the syphilitic antigen tube the serum is tuberculous in addition to being luetic; where there is less hemolysis in the syphilitic antigen tube, the serum is probably only specific, and not tuberculous. The investigation deals with 104 tuberculous subjects and 220 controls, the latter including 100 positive and 100 negative Wassermann's, and 20 serums from persons clinically free from tuberculosis. The results were as follows:

	Positive results			Negative results
	+++	++	+	
Tuberculous cases........				
Treated with tuberculin...	14	16	11	8
No tuberculin............	30	7	11	7
Normal serum...........				20
Negative Wassermann serum..................				100
Positive Wassermann serum..................	7	10	24	59

All the positive Wassermann serums were negative when further tested with the chloroform differential method. The results give therefore 85 per cent positives out of 104 tuberculous subjects, and no positive reactions in the controls. The non-specific reactions observed by others are due to the presence of lipoids in their antigen and in parts to insufficient heating of the serum.—*Diagnosis of Tuberculosis by the Complement Deviation Method, Chung Yik Wang and J. Crockett, Brit. M. J., July 5. 1919, No. 3053, 7.*

Chest Fluoroscopy.—The president of the board of tuberculosis examiners at Camp Lewis finds himself in disagreement in some respects with the article of Diemer and MacRae, on the value of chest fluoroscopy. In dealing with such a complicated subject it must be considered from all points of view, rather than from a selected portion of the material, as was the case with their work in their analysis of the roentgen-ray findings in soldiers rejected on account of pulmonary tuberculosis. The entire report on the subject will be published later, and here Matson says that opinions in regard to the value of the fluoroscope can only be properly formed after a full consideration of the method as used in the examination for tuberculosis is placed before one. He describes the organization and the plan of examination, and as a participant in the fluoroscopic examinations, with Diemer and MacRae, wishes to receive his share of the comment and criticism. The preliminary examiners were selected from the Camp infirmaries, an effort being made to select officers with some special knowledge of the diagnosis. Hence half of the board was constantly changing, while the other half constituted the permanent half, with larger special knowledge and experience. He cites the special instructions given to the preliminary examiners as regards verbal and physical examinations. The conditions found determined the acceptance of the man, if the responses were satisfactory. When a case fell into the classes, with abnormal physical findings or bad family history, the results of inspection, percussion, and auscultation were recorded on the written form, and the man was sent first for fluoroscopic examination, and then to the refer examiner who went over all the forms but did not reexamine unless the roentgenologic or other findings were positive or very suspicious, or tuberculosis was indicated in the family history. Rejections were made by the refer examiners only, and always after reëxamination by them. These rejections were based on physical findings, supported or unsupported by roentgenology. No one was rejected for roentgenologic findings alone. The tabulation of results in the Diemer and MacRae article, however, is a comparison between the findings of the fluoroscopist and those of the preliminary examiners, as the rejections are based on the examinations of the refer examiner, who was the arbiter. "The distinction between preliminary and refer examiners and their respective duties is not brought out in their article. The term 'special examiners' used in the article, should read 'refer examiners,' and 'clinical examiner' should read, 'preliminary examiner.' After recalling that the preliminary examiners, aside from the ten qualified, comprised officers for the most part inexperienced in chest examination, whereas the fluoroscopists had had extensive experience, it must be admitted that this comparison is not a rational one." The diagnoses of Diemer and MacRae were on the whole inferior to those of the inexperienced preliminary examiners, and the final diagnosis of tuberculosis was made by the refer examiner in every case, and needed no fluoroscopic confirmation. The discussion of rejected cases follows, and special points of criticism of the article by the authors named above. Of 2367 men diagnosed tuberculous by the preliminary examiners, 1843

were reported tuberculous or suspicious by the roentgenologist. The refer examiners, however, confirmed the diagnosis of tuberculosis in only 884 cases, of which 570 presented chronic active lesions causing rejection, while 214 were diagnosed healed tuberculosis and accepted. One case is of special interest and is reported. But if the roentgen ray had been accepted for the rejection the country would have lost a good soldier in this case. While appreciating fully the value of roentgenology in the diagnosis, careful physical examination generally predicts what the other can reveal, but the reverse is not universally the case. The author appreciates the services and ability of Diemer and MacRae, and offers his article in a spirit of constructive criticism, with a sincere desire to be fair to both methods. He thinks, however, that Diemer and MacRae have claimed more for roentgenology than it should be expected to reveal.—*The Value of Chest Fluoroscopy, R. C. Matson, J. Am. M. Ass., June 28, 1919, lxxii, No. 26, 1887.*

Roentgen Examination of Tuberculosis Suspects.—Détré found in 80.2 per cent of the 844 soldiers sent to him as suspects that the assumption of tuberculosis was not sustained by the roentgen findings. In these 676 negative cases, the bacteriologic findings were always concordant. The apex shadow frequently looked opaque and grey, but it cleared up and kept clear when the man coughed. By having the subject lean forward or to one side, the second interspace comes into view when otherwise it is hidden by the shadow of the clavicle. In some of the cases, positive findings need not necessarily be of a tuberculous nature. In 40 per cent of the positive cases there was a pleural reaction at the base. Some of the cases also presented the findings characteristic of hilum tuberculosis with a glandular focus, such as has recently been described in children. Three illustrations show the typical findings.—*La radioscopiè chez les soldats suspects de tuberculose, G. Détré, Presse Méd., July 10, 1919, No. 39, 384.*

Exact Shade Measurement in the X-Ray Diagnosis of Thoracic Disorders.—Such terms as loss of transparency, semi-opaque shadow, veiled appearance, complete opacity, commonly used in describing the density of shadows in X-ray plates, are quite insufficient for both scientific and practical purposes. They are no more precise than would be such expressions as slight temperature, high temperature, considerable fever, etc., if used in place of numeral thermometric readings. Normal and pathological X-ray shadows, if of like extent and form, can be distinguished only by differences of shading. Mild and recent pathological changes, as well as congestion and edema show a relatively light tint, while processes of consolidation are generally manifested in deep shadows. Estimation of the amount of fluid present in pleurisy or hydropneumothorax is based in part upon the tint. In serial studies of individual cases of tuberculosis, changes in the depth of shadows are of great significance in showing whether the lesions are progressing in extent or depth, are undergoing sclerosis and calcareous infiltration, or are being absorbed. Two original methods of densimetry or shadow notation are described. The first consists in comparing the shadows at diseased areas with those at certain definite landmarks, viz., the ribs, which correspond in density to 2 or 3 cm. of water; the clavicles, 4 to 6 cm.; the heart, 7 to 8 cm.; the ribs and clavicles superimposed 6 to 9 cm.; the ribs and heart superimposed, 9 to 11 cm., and the liver, 15 to 20 cm. The depth of shadow at the affected area is thus described as costal, clavicular, cardiac, costoclavicular, costocardiac, or hepatic, or is simply noted numerically according to the number of centimeters of water to which it is equivalent. The second procedure consists in radiographing along with the thorax a series of thicknesses of tin or other metal constituting a scale extending from one to thirty centimetres of water. By noting the density of a diseased area and subtracting from it the density of the corresponding area on the sound side of the body, the degree of pathological increase of density can be numerically expressed. In the case of a rarefying process such as emphysema or pneumothorax, the diseased side is subtracted from the sound. The first of the two procedures is simpler, requiring no metallic densimeter, and in practice gives sufficiently precise notations.—*La valeur et la mensuration de la teinte dans le radiodiagnostic des affections thoraciques, M. de Abreu, Bull. d. l'Acad. d. Méd., May 6, 1919, lxxxi, No. 17, 6081.*

Radiologic Findings with Disease of Glands at the Hilum.—Méry with his collaborators class these *adénopathies hilaires* by the roentgen findings in three groups, as they show by illustrated summaries of fifteen cases in children. The three types of findings may be observed in turn in the same child, all starting in the hilum, close to the sternum in the first three interspaces, and running a slow course, with persistence of the physical signs and tending usually to recovery. There is evidently an inflamma-

tory process in the ganglia of the hilum inducing reactions in the neighboring tissues. They have encountered cases of this kind more often since the pandemic of influenza. This may have reactivated dormant processes. In the discussion that followed, Rist emphasized that the fact of retrogression of the lesion does not exclude the possibility of the lung having been involved in the process.—*Les signes radiologiques des adénopathies hilaires, H. Méry, H. Salin, G. Dérré and L. Girard, Bull. d. l. Soc. Méd. d. Hôp., May 22, 1919, No. 17, 471.*

Roentgenographic Diagnosis in Renal Tuberculosis.—In the Mayo Clinic it is the rule to make a complete roentgenographic examination of the urinary tract in every case where renal tuberculosis is suspected. Shadows may be found in approximately 20 per cent of patients with renal tuberculosis; the aid of cystoscopic data may be required in some instances for their correct interpretation. However, positive evidence of tuberculosis may be obtained by this method in certain cases when all other clinical data fail, and when cystoscopic examination is impossible. Shadows due to renal tuberculosis may be arranged in three definite groups: (1) multiple scattered small areas; (2) one single or a few localized areas of 1 cm. or more in diameter; (3) large irregular, diffuse areas involving either a large portion or the entire kidney. The first and second groups represent scattered calcareous deposits. The second is most easily confused with kidney stone. The tuberculous shadow can usually be differentiated by (1) the variability in its density, (2) by its lesser density throughout than is typical of stone, (3) by its irregular and indefinite outline. In the third group, the kidney is usually of putty-like consistency in the area causing the shadow. With complete caseation of the kidney the shadows are most striking; they may assume the outline of a complete cast of the kidney, and are usually irregularly lobulated, the density varying in the different portions. Tuberculous shadows must also be differentiated by careful study of the plates from extrarenal shadows. Roentgenographic evidence of renal tuberculosis may be of value in determining the existence of bilateral involvement. Pyelography is occasionally valuable in the identification of renal infections of a doubtful nature and in the identification of doubtful shadows in the renal area. The cystogram may also give data of value.—*Roentgenographic Diagnosis in Renal Tuberculosis, W. F. Braasch and F. A. Olson, Surg. Gynec. and Obstet., June, 1919, xviii, No. 6, 555.*

Rôle of the X-Ray in the Diagnosis of Long-Standing Renal Tuberculosis.—Many cases of tuberculosis of the kidney can be correctly diagnosed by the use of the cystoscope and ureteral catheter; but in some cases the employment of these instruments is impossible on account of changes in the bladder mucosa. In other cases there is a long-standing chronic tuberculous process with sluggish ulceration and only a few pus cells and no tubercle bacilli are found in repeated catheterized specimens. In cases in which the disease has progressed to complete destruction of the kidney with caseation and deposition of calcium salts, these salts will cast a shadow on the X-ray negative varying in density according to the extent of the process. Where the kidney substance has been largely replaced by calcified caseation a complete outline of the kidney and even the ureter may be seen on the X-ray plate. It is in just these cases that the X-ray will often be the determining factor in diagnosis. It should therefore be a routine procedure to employ the plain X-ray examination previous to cystoscopy and uretral catheterization in all suspected cases of renal tuberculosis, as in some cases the definite diagnosis may be made by this method alone. Whenever possible, however, catheterization of the other ureter should be done to establish the integrity of the opposite kidney. The shadows cast by various types of tuberculous kidney vary from the small indefinite shadow cast by a calcified tuberculous area about a calyx to the characteristic lobulated shadow of a kidney consisting entirely of calcified abscess cavities. The X-ray of such a kidney is unmistakable, but the smaller, indefinite shadows are occasionally difficult to differentiate from renal calculi, and from various extrarenal shadows such as calcified glands, gallstones, etc. A true renal calculus is rarely associated with renal tuberculosis, but in a few cases a calcium oxalate stone has been seen in the pelvis of a tuberculous kidney. Such a stone gives a picture quite different from that encountered when a tuberculous area in a kidney is wrongly diagnosed as stone, when exposed at operation. In the latter case, it is best to remove the diseased kidney, if the other is normal. If the other kidney shows diseased areas, no operative procedure should be attempted. Details of five cases are given with illustrative plates. —*The Rôle of the X-Ray in the Diagnosis of Long-Standing Renal Tuberculosis. J. A. C. Colston and C. A. Waters, Johns Hopkins Hosp. Bull., September, 1919, xxx, No. 343, 268.*

Axillary Dulness in the Diagnosis of Pleural Disorders.—The author calls attention to the utility of percussion in the axilla and infraäxillary region in the early diagnosis of certain pleural conditions. Metapneumonic pleurisy was at times detected in the serous stage by this means, one or two days before the process became purulent. The lives of some patients were saved, furthermore, through the detection of purulent effusions previously overlooked because of the absence of symptoms. From experience in over a thousand cases, he asserts that, given posterior thoracic dulness, axillary or even infraäxillary dulness should direct attention to the possibility of an effusion or adhesive process in the pleura. In acute or subacute chest affections, dulness in the axilla, i.e., above the transverse nipple line, indicates in over three-fourths of all cases the presence of fluid, especially when the level of axillary dulness is higher than that posteriorly. Infraäxillary dulness alone indicates, under similar conditions, the presence of fluid in about one half of all cases. Observation of axillary dulness should always incite the practitioner to the performance of exploratory puncture which, by revealing effusion early, permits of prompt surgical treatment where infection exists. The puncture should be done first in the posterior dull area, then in the axillary and infraäxillary area. In some purulent effusions, with or without accompanying pulmonary disease, axillary puncture alone gave positive results. In such instances, in which the pleura had early become adherent at the base but remained free laterally, the infraäxillary type of drainage recommended by Berard gave promptly successful results.—*Séméiotique: le signe de la matité axillaire dans le diagnostic des processus pleuraux, G. Mouriquand, Presse Méd., March 24, 1919, No. 17, 149.*

Thoracic Puncture Fluids.—Much useful information for diagnosis and treatment can be obtained by investigation of thoracic puncture fluids. Even if aspiration is not indicated for treatment, 5 or 10 cc. may be withdrawn with an exploring syringe for purposes of examination. In a serous fluid coagulation of the fluid should be prevented if possible. If a clot forms it generally contains most of the bacteria and cells and should be examined. More use might be made of immunity tests in serous tuberculous fluids. Though the predominance of the small round cell (so called lymphocyte cell) is almost invariable in simple tuberculous effusions, it is not so in effusions following pneumothorax. In the latter, predominance of polymorphonuclear cells is not uncommon. In the author's series tubercle bacilli were found in 63.6 per cent of pyopneumothorax cases, in 55.5 per cent seropneumothorax, and in 25.7 per cent of apparently simple tuberculous effusions. In the same series, the following percentages of secondary infections were noted: in pyopneumothorax, 18.2; in seropneumothorax, 11.1; in simple tuberculous effusions, none. —*Clinical Pathology of Thoracic Puncture Fluids, S. R. Gloyne, Lancet, May 31, 1919, No. 4996, 935.*,

Attenuation of Tubercle Bacilli.—The object of this short paper is to demonstrate the effect of long-continued and regular subculturing of pure cultures of human, bovine, and avian tubercle bacilli on artificial media containing glycerin. This process has been continued without interruption for twelve years, and the cultivations are luxuriant and grow as readily as in the first year of subculturing. They retain all their characteristics and selective appearances, and can be easily identified as distinct types of tubercle bacilli.—*Attenuation of Human, Bovine, and Avian Tubercle Bacilli. N. Raw, Lancet, March 8, 1919, No. 4984, 376.*

Bacillus Tuberculosis in Tonsils of Children Clinically Nontuberculous.—The excised tonsils from forty-five children were examined for the presence of tuberculosis by means of the inoculation test on guinea pigs, histological examination of sections, cultures on Dorset egg medium and direct smears. In all cases the histologic examinations showed no evidence of tuberculosis, and no tubercle bacilli were demonstrated in any of the cultures or direct smears. The inoculation test yielded a positive result for tuberculosis in only one of the forty-five cases. The bacillus was of the human type. The child was four years of age; the father and mother were living and well; there was no evidence of tuberculosis in the past history of the child; a previous admission to the hospital had been for feeding. Otitis and enteritis had developed, but no tuberculosis had been detected and a von Pirquet test had been negative. At the time of removal of the tonsils the child was well developed and well nourished, and had no palpable cervical lymph nodes. The children in this series came from a community where the supply of cow's milk was far less likely to be contaminated with the tubercle bacillus. Furthermore, but two children in the group were from families in which there were cases of tuberculosis, and none of the children gave clinical evidence of tuberculosis. Although tuberculosis of the tonsils in children is not rare, yet most of the cases occur when there are tuberculous lesions to be found elsewhere

in the body, especially in the cervical lymph nodes. The occurrence of the tubercle bacillus in the tonsils of children without clinical evidence of tuberculosis, however, is not frequent.—*Bacillus Tuberculosis in Tonsils of Children Clinically Nontuberculous, R. S. Austin, Am. J. Dis. Child., July 1919, xviii, No. 1, 9.*

The Organisms of Secondary Infection in Pulmonary Tuberculosis.—The blood of 216 cases of pulmonary tuberculosis was cultured, of which 36 were far advanced, and hematogenous infection was found in 7 of the cases. Four of these, however, were staphylococci, and were probably skin contaminations. Of the others 1 was Micrococcus tetragenus, 1 pneumococcus type II and 1 pneumococcus type IV, with a streptococcus. These results were obtained in broth cultures. All blood cultures in solid media were negative. The case with pneumococcus II was febrile and the case with pneumoccocus IV associated with the streptococcus was afebrile. Both of these positive cultures were in far-advanced cases. The occurrence of pneumococci and streptococci in the blood, as found by these authors, is rather low in view of the findings of Pettit and those of Brown, Heise and Petroff. Of 8 cases which died only 1 yielded a positive blood culture postmortem, pneumococcus type II. This case was negative when examined one week before death. The case in which micrococcus tetragenus was found was moderately advanced. Thirty per cent of the sputa of the 216 cases revealed pathogenic pneumococci and streptococci.—*The Organisms of Secondary Infection, Especially Pneumococci and Streptococci, in Pulmonary Tuberculosis, Corper, Donald and Antz, J. Infect. Dis., 1919, xxiv, 198.*

The Rôle of Measles in Etiology.—A survey was carried out at Camp Grant, under Col. Bushnell's direction, for the purpose of determining the relation between measles and tuberculosis. The work lasted seven months from February to September, 1918. All patients had been examined at the time of their induction into service and their records kept on file at the Tuberculosis Clearing Station. Cases admitted to the Base Hospital with measles were examined two weeks later and six weeks after admission. In all, 596 cases of measles were thus examined. The findings were as follows: one was found to have crepitant râles at the second examination in the right upper lobe, which persisted after cough, but which had entirely cleared up at the third examination, one month later; one was a frank case of reactivated tuberculosis, but this patient had been under observation as suspicious prior to his attack of measles; one was a frank reactivation of tuberculosis attributed directly to the measles. These figures, plus similar ones gathered from other cantonments, seem to vitiate the theory that measles is a predisposing factor towards pulmonary tuberculosis.—*Measles a Predisposing Factor towards Pulmonary Tuberculosis, R. S. Berghoff, Illinois M. J., February, 1919, xxxv, No. 2, 62.*

Latent Tuberculosis in Infants.—Spolverini has applied tuberculin skin tests to 900 supposedly nontuberculous children under one year old, and obtained a positive response in 63. This is 7 per cent in all, but only 0.80 per cent of the 8 infants three or four months old; 2.44 per cent of the 22 from four to six months old, and 3.66 per cent of the 33 from six to twelve months old. The predisposing causes in the infants and in the parents and environment are tabulated, with the pathologic findings in the infants. Radioscopy showed that the glands at the right hilum were affected more often than the left; those at the left hilum do not show unless they are of considerable size, being concealed by other shadows. These glandular lesions could be detected only by raying. From the clinical point of view the tracheobronchial glands are the first manifest localization of the disease. His table reëmphasizes that familial contagion is the most dangerous factor, and that in the cities search should be made for infants born into an infected environment and they should be taken away, into the country, with close medical surveillance.—*Sulla tubercolosi latente nel poppante. Ricerche cliniche e sperimentali, L. M. Spolverini. Rivist. d. Clin. Pediat., April 1919, xvii, No. 4, 169.*

Tuberculosis in Children.—At the Oklahoma City Tuberculosis Dispensary 135 children were examined during 1918. Of these, 50 gave a history of exposure to open cases, 70 pere exposed to suspected cases and 15 gave no history of exposure. One hundred and sixteen gave a history of measles, 50 had pneumonia, 34 had influenza and 86 gave a history of whooping cough. A history of the following symptoms was obtained: cough in 59 cases; expectoration in 29; pain in the chest in 24; pleurisy in 14; hemoptysis in 2; night sweats in 11; loss of flesh in 25; loss of strength in 34; hoarseness in 17; fever in 19; loss of appetite in 28; disturbed digestion in 27. Physical examination revealed the following: weight below standard, 73; height below standard, 17; general appearance good in 95, fair in 48, poor in 21. Type of chest normal in 121, abnormal in 14; super-

ficial lymph nodes palpable in 110 (some were not reported); tonsils hypertrophied in 80; dulness elicited by percussion in 89 (with few exceptions the dullness was interscapular); D'Espine's sign was present in 35; râles in 29. Sixty-nine were examined roentgenographically and the roentgenogram showed tuberculosis of the tracheobronchial glands alone in 11 cases; tuberculosis of the tracheobronchial glands with peribronchial thickening in 29; tuberculosis of the tracheobronchial glands and peribronchial thickening, with involvement of the lung tissue in 19; nontuberculous infection in 3. The diagnosis as recorded in the 135 cases was: tuberculosis of the hilum alone in 34; tuberculosis of the hilum with peribronchial and lung involvement in 44; doubtful, 40; cases with nontuberculous infection, 5; negative, 12.—*Tuberculosis in Children with Special Reference to Tracheobronchial Glands, L. J. Moorman, Okla. State M. Ass. J., May 1919, xii, No. 5. 123.*

Multiple Tuberculosis in Childhood.—The patient, a boy of fourteen, well and vigorous but undersized at the time of the report, had been under almost continuous observation for ten years. The first lesion, noted at the age of four, was an abscess in the left ulnar region, following a fall in which he had struck his arm. Following this a tibial ulcer developed, and later inguinal, epitrochlear, axillary, and costal tuberculous ulcers; mesenteric gland and possibly peritoneal tuberculosis; cervical and bronchial gland—and pulmonary infection. At one time he reacted locally to 0.00001 gm. tuberculin. For a year he has failed to react positively to a Pirquet test. Trauma undoubtedly played an important part in the onset of the disease, as is frequently the case especially in bone and joint tuberculosis. The first infection, however, was certainly not at the site of where the disease was first manifested (the ulna). The history and family history indicate that the primary infection was alimentary and presumably of bovine origin.

At the time of his first entry to the dispensary the abdomen was enlarged; later a mass was palpable in the descending colon. Six years later tuberculosis of the mesenteric lymph glands, and possibly tuberculous peritonitis developed. The pulmonary infection has been very slow and benign, showing chiefly as infiltration of the right lung.

Epitrochlear and inguinal node abscesses did not develop till a year after the ulnar and tibial lesions. Swelling of the legs was noted in the first report and afterward occasionally commented on; it was possibly due to an intraäbdominal lesion. A course of antisyphilitic treatment (mercury and the iodides) was given at first, on account of the obscure symptoms, but without effect. A thorough course of tuberculin therapy was carried out at the dispensary for five years, but no demonstrable benefit resulted. Excellent results however were obtained by life away from home in the country and a sanatorium regimen. The last visit to the sanatorium lasted seven months. The patient returned in good health with no signs of abdominal disease, scars of old adenitis and his weight above normal. For two years since, his condition has been satisfactory without any retrogression. Sanatorium treatment is of the greatest value because it means regulation of rest, exercise and diet, life in the open, and discipline, and above all, relief from strain and worry. The Pirquet test was of especial value in reaching the correct diagnosis. This case also illustrates the favorable prognosis of tuberculosis in childhood. Unless generalized miliary tuberculosis and meningitis supervene, children can recover from a large amount of tuberculous involvement.—*Multiple Tuberculosis in Childhood, A. K. Krause, Med. Clin. North Am., May 1919, ii, No. 6, 1781.*

Bovine Tuberculosis in Children.—Austin analyzes 24 cases of tuberculosis in children and infants with reference to the bovine or human type of infecting organism. The ages ranged from two and one-half months to eleven years, all but 7 died and 14 were autopsied. Determination of the type of bacillus was based on the result of inoculations of rabbits with known amounts of culture. His results show 7 of the 24 to be infected with the bovine type of tubercle bacillus. The 3 living cases, 1 of human type and 2 of bovine are cases of bone or joint tuberculosis apparently localized. There is little indication regarding higher or lower percentage of bovine infection at different age periods. One out of 9 under two years showed bovine infection and all 7 of bovine type are under six years. While this is a small series, finding 7 out of 24 cases to be caused by bovine type of organism emphasizes the importance of this variety of the tubercle bacillus in tuberculosis of children; and, as it is generally considered that bovine infection is through cow's milk the fact that these seven cases occurred in Chicago where all milk is supposed to be pasteurized, points to the necessity of home pasteurization.—*Bovine Tuberculosis in Children, R. S. Austin, Am. J. Dis. Child., April 1919.*

Cattle Must Be Tested for Tuberculosis Before Being Shipped out of Any State. Beginning July, 1919, the shipment of cattle interstate without having them properly tuberculin tested will be prohibited —with a few exceptions—by a regulation issued by the Secretary of Agriculture. The enforcement of this new regulation will, it is believed, be of great assistance in preventing the further spread of tuberculosis among live stock, and having the work practically under State and Federal supervision at all times will serve to bring about uniformity.

The Department of Agriculture, through its Bureau of Animal Industry, is now actively coöperating with the State live stock sanitary officials and cattle owners of 42 States in the eradication of tuberculosis from live stock.

Recent legislation in several of the States has made it possible to proceed with the work where heretofore it has been impossible to do so. Federal funds available for the work are insufficient to meet present demands, and now that the cattle owners are finding the work to be of such advantage and importance the demands will increase rapidly.

Most activities are in the "accredited-herd" work with the owners and breeders of pure-bred herds of cattle who wish to free their herds from tuberculosis and have them placed on the list as "accredited."

Some "area work" is being conducted. Under this plan a community or county or some other unit decides to have all the cattle in the area tuberculin tested with a view of completely eradicating the disease as soon as possible. In order that the "area work" may be successfully carried on, the fullest coöperation of the cattle owners in the territory must be obtained, and any attempt to proceed with the work without the good will and hearty coöperation of the people will fail.

Appropriations by the States for the coming fiscal year for live stock tuberculosis eradication aggregate about $2,000,000. Part of this sum will be used to indemnify partially the owners of cattle found to be tuberculous. Most of the States now have laws permitting the payment of indemnity and the Federal department also pays some indemnity when funds are available. With the exception of valuable breeding animals, it is found most advisable to consign the tuberculous cattle for slaughter and thereby dispose of them to the best advantage. In the greater portion of "reactors" the disease is found to exist to but a slight extent, making the meat fit for food—thereby causing a great saving. The carcasses of such cattle after being passed for food by trained inspectors, usually bring about the market price, which sum, deducted from the appraised value of the live animal, leaves the amount of loss. Under the more recent laws, this loss is divided between the owner, the State, and the United States—each standing one-third—except that in most cases the State is limited in the amount that it can pay and the United States is always limited to the payment of $50 for a pure-bred animal and $25 for a grade.

Owners realize that these slightly diseased cattle may at any time become a source of danger to the healthy animals of the herd and that the latter may break down from the disease and die or become of little or no value. The value of healthy cattle in any herd, after the tuberculous ones are taken out, always increases, and it is a source of great satisfaction to the owner that he has a healthy herd or that he is doing everything in his power to make it so. Cattle from accredited herds are commanding increased prices over those that are not, and those from herds that are in the process of being accredited are also being sold at advanced prices.

The second list of accredited herds and those that have successfully passed one tuberculin test in preparation for the accredited list is expected to be ready for distribution July 1. Requests now received indicate that 100,000 copies will be required to meet demands. This pamphlet of about 100 pages will contain the names and addresses of about 4000 cattle owners, representing about 91,000 cattle, whose herds have passed one or more successful official tuberculin tests applied under the coöperative plan for accrediting herds of tuberculosis-free cattle.

Up to April 1, 1919, the total number of herds under supervision for the eradication of tuberculosis was about 9800, containing about 200,000 cattle; and since that time a large number have been added to the list.

These cattle owners have realized the great importance of trying to maintain a healthy herd, and have pledged themselves to coöperate with the State and Federal officials in every possible way to free their cattle from the disease.

Experience covering a period of several years has proved beyond a doubt that a herd can be freed of tuberculosis and kept free, and that the procedure is entirely practicable and within the power of a large percentage of cattle owners. But to accomplish the desired results everyone connected with the project must do his best to follow plans, in every detail, that will bring it about. The fullest coöperation on the part of the herd owner is very important. A herd of cattle may be declared to be free from tuberculosis by the officials in charge of the work, and then, through some oversight or by

carelessness, diseased animals may be added to the herd or members of the herd may be allowed to associate with tuberculous cattle. In such case, infection may again be introduced and cause further losses and much trouble.

Since the inauguration of coöperative tuberculosis eradication work the number of cattle tested with tuberculin each month has increased.

A total of 252,114 cattle were tested from July 1, 1918, to May 1, 1919. Minnesota leads among the Northern States with about 25,000. Virginia leads the Southern States with 15,796—followed closely by Alabama with 15,094.—*Matters of Current Interest, Am. J. Vet. M., July 1919, xiv, No. 7, 25.*

Tuberculosis in New York Herds.—Dr. W. J. Hoskins, Dean of the Veterinary School of New York University, in speaking before the twenty-ninth annual convention of the New York State Veterinary Medical Society, in Brooklyn, on July 24, stated that in a large measure the high cost of meat, milk, and butter is attributable to the large numbers of cattle destroyed because of tuberculosis each year and the fact that farmers have been unable to replace cattle that have been thus sacrificed. He values the cattle that succumbed to tuberculous disease last year at $8,000,000, and urges that the Legislature be petitioned to appropriate $2,000,000 annually to fight this disease among livestock. He claims that ten thousand persons die annually in this State from tuberculous diseases contracted from dairy products, and that 40 per cent of mothers and 23 per cent of the infants are under-nourished because of the poor quality of the milk produced by unhealthy cows. The society adopted resolutions urging that dairy farms and milk bottling establishments be systematically inspected at regular intervals. —*News of the Week, Med. Rec., August 2, 1919, xcvii, No. 5, 202.*

Nature and Treatment of "Scrofulous" Ophthalmia.—Wolff apologizes for retaining this term, but says it conveniently classifies the cases in which at some time there has been a tuberculous inflammation in the eye, leaving it hypersensitive to the tuberculous toxin. Certain lymph glands in the vicinity may also have been the seat of a tuberculous process which may or may not have subsided into a latent stage. In any event, the tuberculous toxin occasionally gets mobilized, and when it reaches the hypersensitive eye it induces phlyctenules. The latter do not develop in animals, and tuberculous processes in the neck glands seldom occur in animals except possibly in the hog. Wolff urges examination of the eyes when tuberculous processes are found in the cervical glands in hogs. It is possible that obstinate eczema may likewise be a manifestation of local toxic action on a healed tuberculous lesion which has left the area hypersensitive. Other germs play a secondary but important rôle. Treatment may aim to abolish the tuberculous foci generating the toxins which act on the eye, or it may aim to reduce the sensitiveness of the eye. A course of tuberculin would aid in the latter, but roentgen treatment of the tuberculous glands has proved the simplest and easiest method to eradicate the toxin-generating foci. No operative measures were attempted except to aspirate when necessary. At most 4 H. units were given at a time, with an aluminum filter 5 mm. thick. Roentgen exposures have no influence on the phylctenular inflammation or corneal ulcer itself, but exposures of the tuberculous glands dry up the streams of toxins at its source. As adjuvant he has found silver fluorescine useful, especially in a 5 per cent salve in white petrolatum, applying a little every hour in the conjunctival sac. The same principles were applied in treatment of benign tumors of the eye, and the glandular lesions in the neck retrogressed without recurrence in three or four cases, but the eye lesion was not influenced, in contrast to what is observed with the phlyctenular ophthalmia. The latter disappears as the glandular lesions retrogress, as he shows in a table of fourteen cases. After removal of a sarcoma of the conjunctiva in another case, the eye was subjected to roentgen exposures and no harm seemed to have been done, no microscopic changes from them were evident when the eye was enucleated over two years later on account of recurrence of the sarcoma. Encouraged by this, he applied the roentgen rays directly to the eye and with brilliant success in his first two cases. One was a girl of eighteen with iridocyclokeratitis and numerous nodules in the iris; the other patient had keratoscleritis with an ulcerating nodule in the cornea. The lesions were entirely cured in a few days, but there was recurrence in the second case. In three other cases of scleritis great benefit was derived, but not so promptly. The lymph glands had better be exposed at the same time.—*Scrofulous Ophthalmia, L. K. Wolff, Nederl. Tijdschr. v. Geneesk., April 12, 1919, ii, No. 15, 1168.*

Tuberculous Iridokeratitis.—Detailed histories of four cases of tuberculous iridokeratitis are presented. Parsons classifies tuberculous lesions of the iris as follows: (1) Miliary tubercle; (2) confluent or conglom-

erate tubercle; (3) tuberculous iritis. The four cases presented were all of the third type, which clinically may be indistinguishable from other forms of chronic iritis, but microscopic sections reveal tubercles or the presence of bacilli. In case 2 one lesion appeared anteriorly near the pupillary margin, with a second directed backward, and not far from the root of the iris. In case 3, one nodule was definitely at the root of the iris and one also in the ciliary body, with a secondary, or associated, tubercle in the substantia propria. In case 4 the infiltration was so intense that actual tubercle tissue could not be detected in the iris. All of the cases were females, ages ranging from eighteen to forty-six years. In case 1, although no primary source of infection could be found, there was a suggestive family history of tuberculosis. Case 2 showed inflamed glands of the neck. Case 3, in whom no actual clinical lesion could be found, exhibited a positive tuberculin reaction after the eye had been removed. Case 4 was a robust heavy woman, but gave a marked focal reaction to 2 mgm. of O. T., with a corresponding general reaction. In the cases the nodules were more numerous on the posterior than on the anterior surface of the iris. They consist at first of mononuclear leukocytes without any epithelioid cells. When left for a long time and allowed to increase in size large mononuclear cells with pale staining nuclei are found in the center of the nodule. Tubercle bacilli could be demonstrated only where central caseation of the individual tubercle had occurred. In the more malignant form where a parenchymatous keratitis ensued, the iris was generally studded with tubercles, the center of which was usually necrotic. The sections, especially those of cases 3 and 4 show a distinct change of the endothelial cells of the cornea. In animals inoculated, as well as in human cases recorded by Stock, Descemet's membrane always remained intact. Case 4 of this series is an exception to this rule, the membrane behind being covered with lymph, and above by a distinct infiltration of lymphocytes and numerous giant cells suggesting early necrosis.

Verhoeff has stated that the size and number of lesions are greater at the filtration angle than elsewhere. Sections from this series of cases do not necessarily substantiate this fact, although showing the almost constant association of corneal involvement with tuberculous iritis. The iris itself is more involved than any other part of the eye; and the lesion in the cornea is more often opposite the pupillary area than about the filtration angle. There was evidence of an active or acute inflammation of the choroid in only one case—Case 4. Case 3 showed what might develop into a retinal tubercle.—*Tuberculous Iridokeratitis, F. T. Tooke, Am. J. Ophthal., June 1919, ii, No. 6, 395.*

Fulminating Tuberculosis of Tracheo-Bronchial Glands.—Dumas describes five typical cases of this unusual form of tuberculosis as he observed it in five African soldiers at Salonica. The men entered the hospital with the diagnosis of bronchitis and died in two or three months, necropsy showing tuberculous involvement of the mediastinal lymphatic system with secondary invasion of pleura and pericardium. Some of the glands broke down into a purulent focus while the lungs escaped almost entirely. The cases all proved rapidly fatal, none lasting for over three months. Radioscopy differentiates the disease but the temperature determines the prognosis. The clinical picture is more like those observed in children than in adults, but even in children such a fulminating form is almost unknown while it seems to be the rule in the blacks of the French colonies in Africa.—*Adénopathie trachéobronchique tuberculeuse à marche rapide, A. Dumas, Lyon Méd., April 1919, cxxviii, No. 4, 180.*

Bilateral Spontaneous Pneumothorax.—A man, aged thirty-two years, a victim of pulmonary tuberculosis had a violent coughing spell, marked by a sudden pain in the right side and followed shortly by dyspnea. The diagnosis of spontaneous pneumothorax, right, was made. Aspiration of the right chest was immediately done and 2000 cc. of air withdrawn; the patient promptly rallied and became comfortable. Ten hours later, it became necessary to aspirate again. The escape of air from the lung increased and it was soon found necessary to aspirate at shorter intervals. Because of extensive disease of the left lung, the latter did not contain enough aerating tissue to sustain life. Nevertheless, to determine the point, the trocar was allowed to remain open in the chest wall on the pneumothorax side, creating, in effect, an open pneumothorax. Within a very few minutes, the patient showed great distress and aspiration was done. Effusion soon appeared and this, in a short time, showed infection. The amount of fluid soon became great and required frequent aspiration. Air began to diminish in quantity. On the fourteenth day a fistula occurred in a needle track. The skin opening was fortunately trapped and, while coughing expelled air and fluid (pus and seropus), there was no intake through the sinus. It was now decided to attempt to

bring the lung down; to this end, continuous siphon drainage was established, with the result that by June 18 (the twenty-third day) breath sounds were heard over the right upper lobe as far down as the third rib, and respiration became much easier and the patient was able to lie on the pneumothorax side. On the seventh day an extensive emphysema occurred and involved the chest, abdomen, scrotum, penis, neck and face. June 19 the patient complained of shortness of breath; aspiration of the right chest was done, but little relief was afforded. The trocar found the base of the lung in the fourth space. Examination of the left lung showed diminution of breath sounds. June 20 the patient was found to be much worse. While fair respiration was being performed by the right lung, the left lung presented no sounds whatever. The patient complained of some pain in the left lung, but of very little dyspnea. Aspiration of the left chest relieved the patient of 1800 cc. air, but did not improve the general condition. He was comfortable until his death, which occurred twenty-four hours after the second rupture. —*Case of Bilateral (Double) Spontaneous Pneumothorax, E. A. Gray, Illinois M. J., May 1919, xxxv, No. 5, 252.*

Effusion with Induced Pneumothorax. —Breccia ascribes to the compression on the vessels in the hilum of the lung the disturbance in the circulation which is the main cause of the pleural effusion with therapeutic pneumothorax for pulmonary tuberculosis. This is also the cause of the effusion with heart disease, the enlarged heart pressing on the hilum and compressing its vessels. This explanation is a guide to treatment, as the presence of fluid in the pleura may push down the diaphragm or displace the mediastinum, and thus mislead one as to the absolute pressure in the pleura in inducing the pneumothorax. The effusion is liable to be rapidly resorbed, modifying completely pressure conditions with the pneumothorax, unless measures are taken at once to maintain the curative pressure on the lungs which abates as the fluid is absorbed. If the effusion shows a tendency to remain stable, it should be left alone, as also when the effusion displays a progressive tendency unless it becomes excessive, when it requires treatment as for any pleural effusion. The pleural effusion alone may exert the desired pressure on the lung, and in connection with the pneumothorax may regulate automatically the hydropneumothorax. He discusses further the indications when the effusion is purulent, mentioning parenthetically that the 12,000 soldiers passing through his service in the last two years amply demonstrated that the lung is able to expand and recuperate function almost always after a war wound of the chest affecting a sound lung. In the tuberculous lung, however, conditions are different, and time alone will show what share the pleuritic changes have in the final outcome of recovery under induced pneumothorax.—*Contributo allo studio delle pleuriti essudative nel pneumotorace terapeutico della tubercolosi polmonare, G. Breccia, Rivist. Crit. d. Clin. Med., April 19, 26 and May 3, 1919, Nos. 16, 17 and 18.*

Serous Membrane Tuberculosis.—Two cases are presented, one of tuberculous peritonitis and one of tuberculous pericarditis, both in negro boys 14 years of age. In the first case the abdomen was greatly distended, and even after the removal of 4 liters of clear serous fluid, the abdominal wall was still tense and tender. There was a high irregular fever and leukocytosis. In the second case, the chief symptom was pain over the heart, with shortness of breath, increase in the area of cardiac dulness, irregular fever and rapid pulse. Under the X-ray the heart shadow had not the characteristic triangular form extending up to the neck.

Tuberculous peritonitis may be either ascitic or dry. In children the ascitic form is usually easily diagnosed; in adults it may be confused with cirrhosis of the liver or carcinoma of the peritoneum. Typical constitutional symptoms and tuberculous foci elsewhere aid in the diagnosis. In the dry form diagnosis is more difficult, the symptoms suggesting various surgical conditions, so that the true condition is often discovered only at operation. Frequently curious abdominal tumors are found and lead to errors. These tumors are formed by the rolled-up omentum, by encapsulated fluid, by matted intestines, by enlarged glands, or by pelvic masses—the first named being the most common. Tuberculous peritonitis is a serious tuberculous manifestation and the prognosis is always grave. Of the patients who had been in the hospital, 48, or 32 per cent died, 16 were cured, and 71 improved. Forty-three cases were heard from after leaving the hospital: of these 14 had died, 7 were reported living but not quite well; 22 were reported living and well. The chief question in the treatment of tuberculous peritonitis is that of operation. Statistics are unsatisfactory, and the value of operation is not proved. Tuberculous pericarditis is much less common than tuberculous peritonitis, and a less serious manifestation. Tuberculosis of any serous membrane is a local anaphylactic reaction in an already infected person. Only on this basis can the acute onset, the fibrinous exudate and the serous effusion be explained.

A subserous focus of disease may cause serositis without the tubercle bacilli actually reaching the surface. The bacilli are in fact rarely found in the serous effusion. More than one serous cavity is often affected. Autopsy records of 35 cases of tuberculous peritonitis show: 12 cases had an associated peritoneal and pleural and 9 more showed pleural adhesion without demonstrable tubercles; 2 cases had associated peritoneal and pericardial tuberculosis, and 1 more an adherent pericardium without demonstrable tubercles; 1 case showed tuberculosis of all 3 serous membranes; 2 cases had adherent pleurae and pericardium without demonstrable tubercles; 1 case, peritoneal and pleural tuberculosis with adherent pericardium without demonstrable tubercles.—*Serous Membrane Tuberculosis, L. Hamman, Med. Clin. North Am., May 1919, ii, No. 6, 1747.*

Tuberculous Pericardial Effusion.—A man of 21 on admission to the hospital complained of weakness, headache, pains in both sides of the chest, cough, and shortness of breath. Physical examination showed relative dulness over the left lung in front, impaired note over the lower part of the left chest in front, with pleural friction and râles. Later the chest showed rhonchi throughout. Both physical examination and the X-ray showed a large pericardial effusion; 500 cc. of clear fluid was aspirated, but the sac filled repeatedly and frequent aspirations were necessary. Large quantities of fluid were removed; 2050 cc. on one occasion, over 1000 cc. several times. The fluid contained lymphocytes and was sterile, which clearly pointed to tuberculosis. The special features of the case are the extreme distention of the pericardial sac, the large quantities of fluid removed at aspiration, the marked relief afforded by the early aspirations, and the remarkable tolerance shown in the later stages to the presence of large accumulations of fluid.—*Case of Recurring Effusion into the Pericardial Sac, H. B. Roderick, Lancet, June 7, 1919, No. 4997, 980.*

Tuberculous Peritonitis.—It has become a custom with some surgeons when operating for tuberculous peritonitis to remove the tubes whether there is a mixed infection or not, in order to close an avenue for the entrance of tubercle bacilli. It is often difficult to determine where the disease in the peritoneum started. Whether the tubercles are always brought through the lymph channels or whether it is possible that some may come through the intestine by a sort of diapedesis, the tuberculous trouble of the peritoneum seldom comes from the vagina or uterus, to be poured out at the end of the tube. Such a case has never been demonstrated. The point is that tuberculous peritonitis is of systemic origin, and that, while the tubercles are deposited in the peritoneum in large amount, they are rapidly absorbed after the simple operation, and the few that may be in the uterus or tubes are also cared for by Nature. The only condition in which the removal of the tubes is justifiable in this operation is when another kind of infection has taken place in the tube either before or after the tuberculous deposit on the peritoneum. Then in many cases we should remove the pus tube completely. But even then simple resection of the tube or some part of it may be sufficient. A brief note of a case is given which shows that pregnancy may take place and a successful delivery occur after a conservative operation for tuberculous peritonitis. It is true it is sometimes difficult to diagnose these cases, and operation for other conditions may reveal a tuberculous peritonitis. Carstens describes his own technic as follows: "In my earlier cases I washed out the peritoneum with a 1 : 10,000 mercuric chloride solution. A quart of the solution is poured in, the opening is closed with the hand, and the body is shaken so that the fluid comes in contact with every part of the peritoneum. I think this irritates and stimulates the peritoneum—probably produces phagocytosis. I do not know whether the mercuric chloride does any good, but I know it does no harm, as I empty the peritoneum and then put in a saline solution—gallons and gallons of it—and wash the peritoneum out thoroughly so as to be sure that there is no mercuric chloride solution left behind to produce poisoning. I then sew up the abdomen with No. 2 plain catgut in layers, closing first the peritoneum, then the muscle and then the fascia with a running suture. I never sew up the skin. I use sterile adhesive plaster, and the wound generally heals promptly. Formerly I used silkworm-gut or silk sutures, but as these act as a drain, and in the tract of each suture a deposit of tubercles made its appearance and each stitch hole showed a dark red spot as seen in healing or healed tuberculous sinuses. I stopped this method of closure. Drainage of the wound is not considered, because, first of all, it does not drain, and secondly, draining is liable to result in the development of fistulas and ulceration of the bowel."—*Desirability of Preventing Sterilization in Young Women, when Operating for Tuberculous Peritonitis, J. H. Carstens, J. Am. M. Ass., July 5, 1919, xxiii, No. 11.*

Tuberculous Cirrhoses.—In the liver, kidneys, salivary glands and pancreas we see specific granulation tissue develop on the

basis of tuberculosis, spread diffusely, contract and give rise to cirrhotic processes which entirely resemble cirrhoses due to other causes. In tuberculous cirrhosis of the liver the interstitial process is primary, the transformation of the tissue is secondary. A splenic tumor does not belong to the pure picture of tuberculous cirrhosis. The diagnosis can only be made with the microscope. The disease is caused by tubercle bacilli of low virulence or by a relatively small number of bacilli in a carrier of high resistance.—*Ueber tuberkuloese Lebercirrhose, tuberkuloese Schrumpfniere und analoge Erscheinungen granulierender tuberkuloeser Entzuendungen in Pancreas und Mundspeicheldruesen, E. Kirch, Arch. f. path. Anat., 1918, ccxxv, No.* 2.

Gastric Tuberculosis.—Razzaboni gives the microscopic findings in a case of tuberculosis of the stomach in a woman of sixty, with complete recovery after subtotal gastrectomy. The symptoms from the stomach had first been noted about two years before the operation. The process was of a neoplastic type along with diffuse inflammatory lesions. When last seen, three years and a half later, she was still well.—*Gastrectomia subtotale per tubercolosi gastrica a forma pseudo neoplastica, G. Razzaboni, Policlin., May 1919, xxvii, No. 5, 153.*

Intestinal Tuberculosis.—In view of the uncomfortable symptoms of intestinal tuberculosis and the difficulties of giving relief, anything that will increase our medical armamentarium effectively will be welcome. About six months ago Saxtorph published his results with the intravenous injection of calcium chloride in intestinal tuberculosis. Fishberg has tried this in his hospital and private practice with results which he thinks warrant recommendation of the method. In some cases Saxtorph's reports were fully confirmed; one or two injections gave relief. The method is effective in early cases of intestinal tuberculosis. The benefit is reduced gradually with the longer continuance of the symptoms. When the diarrhea in a tuberculous patient is due to dietetic indiscretions, to the catarrhal condition of the intestinal mucous membrane, or to slight intestinal ulceration, an intravenous injection of 5 cc. of a 5 per cent solution of calcium chloride will give prompt relief. When, however, the intestinal symptoms are due to extensive ulcerations—especially to amyloid infiltration of the intestine—the chances of attaining relief from the pain and annoying diarrhea are remote. Similarly, when the abdominal pains are due to irritation of the intestinal mucous membrane by the contents of the intestine, relief may be attained by intravenous injection of calcium chloride. When, however, the pains are due to localized peritonitis over deep intestinal ulcers, or to peritoneal adhesions, which are not uncommon in tuberculous subjects, calcium chloride is impotent to give relief. The mode of action of the drug can only be surmised. We cannot explain it on the theory of lime starvation said to be a strong etiologic factor in tuberculosis, because it does not relieve other symptoms. On the other hand, Loeb found that calcium salts stop contact irritability of muscle and hypersensitiveness of the nervous system induced by various salts. It has also been found that calcium salts impede and even stop intestinal peristalsis, and, at times, even counteract the effects of certain laxative drugs.—*Calcium Chloride as a Palliative Agent in the Treatment of Intestinal Tuberculosis, M. Fishberg, J. Am. M. Ass., June 28, 1919, lxxii, No. 26, 1882.*

The Sexual Functions in Women in Relation to Defense Against Tuberculosis.—Lasbennes tabulates the statistics of the tuberculosis mortality at Madrid since 1900, classifying it by sex and age. His figures show a striking reduction in the tuberculosis death rate in women during the childbearing age and later in comparison to the male death rate. Up to the age of twenty the female death rate keeps about the same as the male or surpasses it. From ten to nineteen the proportional percentage was males, 41.26, 40.91, 38.22, 47.42 and 41.24, while in females the corresponding figures were 58.74, 59.09, 61.78, 52.58 and 58.76. After twenty the female death rate ranged from 29.59 to 49.46 as the extreme figures, while the male death rate ranged from 50.54 to 70.41, and averaged over sixty. If experiences elsewhere confirm this relative lesser receptivity of women and the greater receptivity of girls after puberty, the practical deduction would be to prescribe matrimony in certain cases of "pretuberculosis" instead of forbidding marriage in such conditions, as is often done. There is a possibility also that ovarian treatment might prove an effectual adjuvant in treatment of tuberculosis.—*Influence of Sexual Functions in Women on the Defense against Tuberculosis, L. Lasbennes, Medic. Ibera, May 17, 1919, vii, No. 80. 123.*

Tuberculosis of Intestines.—A girl of 17, suffering from pulmonary tuberculosis for three years, had been operated for appendicitis eight months previous to the report. The appendix was found normal. After the operation a persistent enteritis and colitis developed, causing loss of weight and strength,

and tubercle bacilli appeared in the stools. The pulmonary condition also grew worse. Roentgen ray examination showed a very rapid emptying of the small intestines as well as of the colon; fluoroscopic and radiographic examination of the colon by means of a barium enema showed a definite filling-defect at the lower pole of the cecum and the ascending colon. At operation tuberculosis of the transverse and ascending colon, cecum and ileum was found with a large mass involving the junction of the distal ileum and the cecum; many small tubercles were seen on the large intestine. The last 12 inches of the ileum, the cecum, the ascending and part of the transverse colon were resected.—*Case of Tuberculosis of the Intestines with a Defect at the Cecum, P. M. Lund, Am. J. Roentgenol., September 1919, vi, No. 9, 453.*

Tuberculosis of the Sphenoid.—A colored woman, aged thirty-one, complained of intermittent fever, loss of weight, pain in the head, localized chiefly in the occipital region, but radiating toward each mastoid; later it extended towards the right ear. Physical examination showed a polypoid mass in the region of the posterior end of the right middle turbinate, and a mucopurulent discharge far back in the nasal cleft on the same side. On transillumination the right antrum appeared dark. The X-ray showed a distinct clouding of the right ethmoid region, with duling of the bony outline of the right sphenoidal fissure; the lateral view showed marked clouding of the sphenoidal sinuses. There was nothing to indicate an acute pulmonary tuberculosis. At operation the right sphenoidal sinus was full of friable tissue resembling granulation tissue, a considerable amount of which was removed. On section this tissue proved to be tuberculous. The antrum appeared to be healthy except posteriorly where the mucous membrane was thick and edematous; the posterior ethmoid cells were found to be full of pathological material, and the bony walls necrotic; the floor and anterior wall of both sphenoidal sinuses were similarly involved. All the diseased material was removed as far as possible. The polypoid mass in the nasopharynx proved to be tuberculous tissue and was removed. The wounds healed promptly and the patient reacted favorably. Tuberculosis of the nasal sinuses is rarely reported. The symptoms are those of a chronic sinusitis. The constitutional symptoms of tuberculosis may be slight. The treatment should be surgical in addition to constitutional treatment with the use of tuberculin. If the disease can be eradicated the prognosis is good, but in such extensive cases as the one reported, a recurrence is to be expected.—*Tuberculosis of Sphenoid Sinus, T. D. Kernan, Laryngoscope, May, 1919, xxix, No. 5, 276.*

Erythema Nodosum and Other Skin Lesions in Tuberculosis.—Tuberculids or paratuberculoses are sometimes defined as a group of skin affections, associated with tuberculosis of other structures of the body, but which do not themselves show the anatomic picture of tuberculosis, to which they consequently seem to have only an indirect relation. Some of the well recognized members of this group are acnitis, lichen scrofulosorum, and acne scrofulosorum. Dermatologists are not agreed as to the causative factor of these lesions, some believing that they are due to "tuberculous toxins," while others hold that the lesions are due to actual reactions to hematogenously distributed tubercle bacilli. Recently Stokes of the Mayo Clinic has discussed the frequent association of erythema nodosum, purpura, and erythema multiforme in patients who suffer from more or less well concealed forms of tuberculosis. This writer believes that such lesions are cutaneous reactions to hematogenously distributed tubercle bacilli, deposited in a hypersensitive skin, and originating in a tuberculous focus, perhaps unrecognized for years. Other investigators have noted the association of tuberculosis and erythema nodosum, and the question remains whether the association is of etiologic significance or merely one of coincidence. According to the definition of a tuberculid, erythema nodosum might be classed perhaps in this group of skin affections, as there is no evidence at hand to warrant the assumption that the lesions are due to hematogenously distributed tubercle bacilli. The work of Rosenow will be recalled, particularly the production of lesions suggesting erythema nodosum in animals by the intravenous injection of a diphtheroid Gram-positive diplobacillus, which he found in a series of eight cases of erythema nodosum. Stokes points out that the pathology of erythema nodosum is such that it seems a rash assumption to attribute it to a single type of organism. But he did not make microscopic and bacteriologic studies of the skin lesions in his cases. He did study the cervical or axillary glands in a few cases, and while many glands were found tuberculous, it is not safe to assume that also the associated skin lesion necessarily must have been due to reactions to the tubercle bacillus. The difficulties in the way of bacteriologic and microscopic study of skin lesions in patients are apparent; but such study is, of course, the only way to substantial progress. The association of erythema nodosum and other skin manifesta-

tions with tuberculosis is of great interest, and the exact nature of these skin lesions requires further investigation.—*Current Comment, J. Am. M. Ass., July, 1919, lxxiii, No. 3, 196.*

Pityriasis Rubra Pilaris.—The authors describe a case of this condition seen by them in the Soudan and discuss at length the diagnosis of the disease from allied or similar disorders. Their conclusion is that the pityriasis rubra pilaris of Devergie is a disease quite distinct from the lichen planus of Erasmus Wilson and probably also from the lichen neuroticus of Unna, which may be the same as the lichen ruber of Hebra. It is probably caused by a toxin which may arise as an anaphylatoxin, of which the anaphylactin factors are amboceptors present in the skin cells and due to action, at some time or other, of the tuberculous toxin. It is a disease quite distinct from acnitis or lichen nitidus and from lichen scrofulosorum. Many points indicate a partial similarity of causation with ichthyosis. From the latter disease it is to be differentiated clinically by not dating back to within a short period after birth and by the presence somewhere of the associated erythrodermia. From the lichen spinulosus of Devergie it is distinguished by the eruption being general, by attacking the hands, and by the follicular slug being scaly and not shiny. From pityriasis rubra it is distinguished by the relatively slight amount of erythema, by the small scales, by the typical hard conical papules in the follicles on the dorsal aspects of the first phalanges of the fingers, by the absence of constitutional symptoms, and by its benign and chronic course. The authors also describe the differential diagnosis from the lichen convex of Castellani, the keratosis suprafollicularis of Unna, the lichen planus of Erasmus Wilson, the lichen neuroticus of Unna, and a number of other skin conditions. The treatment must be long continued, and in a recent case must aim at neutralizing the exciting toxin.—*Sudanese Examples of Two Common Hyperkeratoses, A. I. Chalmers and A. Innes, J. Trop. Med. and Hyg., June 2, 1919, No. 11, 97.*

Tuberculosis of the Cervix Uteri.—Primary tuberculosis of the cervix is extremely rare, probably not more than 15 or 20 cases having been reported. Of secondary tuberculous infections of the cervix about 150 cases have been reported. Many others have probably been unsuspected, or have been diagnosed as cancer, syphilis, etc. Infection in secondary cases may be by the blood stream from the primary focus, by direct extension of the process from neighboring organs—tubes, ovaries, uterus, etc., or by external means. In primary cases, the infection must be from external sources. Coitus is the most frequent method of external infection in tuberculosis of the cervix. Although there are no statistics to show how many cases are due to some lesion in the husband, probably all the primary cases and a large percentage of the secondary cases can be attributed to this cause. Infection from handling with unclean hands, infected instruments in making examinations, etc., is also possible. There are four varieties of tuberculosis of the cervix commonly mentioned, and two rare forms. These are: (1) miliary, (2) interstitial, (3) vegetating, (4) ulcerating; and the rare forms: (5) catarrhal form of Schutt, (6) inflammatory form of Cotte. In the majority of cases all types begin in the cervical canal; in the later stages all types develop into the ulcerative form with purulent vaginal discharge and more or less hemorrhage. The subjective symptoms of tuberculosis of the cervix are vague and indefinite. As in many cases the uterus, tubes or ovaries are involved, symptoms may be referable to these organs. Leucorrhea is the most common symptom; the discharge is slight and mucopurulent in the early stages, becoming later profuse, purulent and offensive. Slight bleeding after coitus is fairly frequent. In late stages there may be considerable blood in the discharge. In most cases the general condition is good unless there is an active tuberculous process elsewhere. Amenorrhea may be a symptom. All types and stages of the disease resemble carcinoma. In distinguishing between the two, the history of the case, the age of the patient, and the appearance of the discharge are to be considered. Tuberculosis occurs more frequently in younger patients during the period of sexual activity. The purulent discharge differs from the blood-stained serum characteristic of cancer. Pain is slight and indefinite in tuberculosis. The diseased tissues in tuberculosis are soft and velvety to the touch; in cancer, friable. It is desirable to take a specimen for study in any case; in some cases resort must be had to guinea-pig inoculations and the von Pirquet test. The method of treatment must depend upon conditions of the individual case. Where there is an active tuberculous process elsewhere, excision of the local process will be of no benefit; but where other lesions are healed or dormant and the cervical lesion progressing, a conservative or radical operation may be indicated. Where uterus and tubes are extensively involved and the question of child bearing is not to be considered, a panhysterectomy is indicated; in cases

where the lesion is local, and the general health good, amputation of the cervix preferably with the cautery, or cauterization of the infected areas should be done. The prognosis is good if the process is definitely localized, and the infected portion can be completely eradicated. A case in a married woman aged 27 is reported. The only symptom was an occasional slight vaginal hemorrhage, which was also noticed regularly after coitus; general health excellent. On palpation of the cervix there was a nodular feel about the os, especially on the posterior side, the examining finger being slightly stained with blood. The speculum examination showed a region of bright red color about one-half inch in width about the os, with a small ulcer on the posterior side; a few small grayish and yellowish nodules in the visible portion of the canal. A specimen removed from the posterior lip showed tuberculosis. A vaginal hysterectomy was done. Microscopic examination showed tuberculosis of the tubes, fundus of the uterus and cervix of the miliary type with early ulceration. Convalescence was good; and the general health a year later was excellent, but there was a foul leucorrhea, indicating apparently a recurrence of the tuberculous process.—*Tuberculosis of the Cervix Uteri, G. A. Moore, Surg., Gynec. and Obstet., July, 1919, xxix, No. 1, 1.*

Tuberculous Origin of Lymphogranulomatosis.—Näslund found nothing to suggest a tuberculous origin at necropsy of a typical and extreme case of lymphogranulomatosis in a boy of four. None of the internal organs or tissues showed any changes even suspicious of tuberculosis. An emulsion of one of the lymphogranulomatous mesenteric glands was injected into the peritoneum of two guinea-pigs and both died of generalized tuberculosis. The tubercle bacilli found in the guinea-pigs were true to the human type, as also those recovered from white mice and rabbits. The lesions found in the animals corresponded to those induced with ordinary human tubercle bacilli, but some of the rabbits developed also certain changes which seemed to resemble in every respect typical lymphogranulomatosis, along with the ordinary typical tuberculous changes. The extensive researches reported, with four pages of bibliography, set solid, all tend to confirm the assumption that lymphogranulomatosis is a form of tuberculosis, the individual reacting forces determining the form in which the disease manifests itself. The tubercle bacilli involved are not necessarily attenuated in virulence.—*Lymphogranulomatosis of Tuberculous Origin, C. Näslund, Upsala Läkareফ*

Tuberculous Lymphoma and Tuberculosis.—The entire supplement of the *Upsala Läkareförenings Förhandlingar*, issued July 20, is devoted to contributions by Wallagren on this and other phases of tuberculosis. In his main contribution he deals with the relationship of scrofulous glands to future tuberculosis. He has used the material of the Upsala Chest Clinic to throw light on a subject in which contending views have long been maintained. According to the followers of Marfan child scrofula immunizes against tubercle, while Aufrecht, years before, announced the exact opposite. The author endeavored to follow up 256 cases of surgical scrofula—cases in which operation had been performed—and obtained data in 251. He found that 95 of these were dead, while of the balance 129 could be examined by himself or other medical men. The cause of death in the 95 could be fixed so that the net number amounted to 224. It appeared that, combining the living and dead, 158 subjects had sound lungs, 62 had some form of tuberculosis in after life, of which 46 were cases of pulmonary location, while in the few scattering cases no opinion was reached. The percentage of lymphoma patients to present pulmonary tuberculosis in nearly 1,000 cases was 15 in outside material; while in the author's cases it was a little above this figure. These figures are somewhat higher than in control cases, but do not prove that lymphoma predisposes to other forms of tubercle. Apparently both Marfan and Aufrecht represented extreme viewpoints and the author's figures suggest a mean between the two.—*Editorial, Med. Rec., June 14, 1919, xcv, No. 24, 1011.*

Influenza and Tuberculosis.—The author reviews the influenza epidemic among the 175 tuberculous patients and the 50 nontuberculous employees of the Montefiore Home Country Sanatorium, Bedford Hills, N. Y. and comes to the following conclusions: (1) The epidemic of influenza appeared at the sanatorium several weeks later than at New York City, which is forty miles south, and only forty-eight hours later than in the nearest village, a half mile from the institution. (2) Tuberculous and nontuberculous subjects seem to have been equally susceptible to influenza, the incidence in each case being twenty-four per cent. (3) Early and advanced cases were equally affected. (4) Pneumonic consolidations oc-

curred as frequently in the nontuberculous as in the tuberculous. (5) There was a mortality of 11.4 per cent due to the epidemic. (6) Careful observation for four months, and reëxamination of all patients so affected at the end of this period, showed that all the patients but two were none the worse for their experience, their general condition being as good as might have been expected normally. (7) So far there seems to be no increase in the number of tuberculous patients seeking admission to our sanatorium, as a result of influenza, and more cases are erroneously sent to us for treatment on account of basal lesions than in corresponding periods of the past two years. —*The Effects of Influenza on Pulmonary Tuberculosis, B. Stivelman, N. York M. J., July 5, 1919, cx, No. 1, 20.*

Influenza After-Effects.—An account is given of the influenza epidemic of 1918 which struck Buffalo with the suddenness of a cyclone. The disease appeared October 1, with 21 reported cases. By October 14, they had the highest number reported in one day, namely, 1886 cases with 48 deaths from influenza, 7 from pneumonia and 7 from bronchopneumonia. From that date on there was a gradual decline. It was a physical impossibility for physicians to see most of the patients more than once, hence many cases of pneumonia were reported only as influenza. It was only after the crest of the epidemic wave had passed that anything like accuracy in morbidity statistics was possible. Gram gives an account of the measures taken by the health authorities; the prohibition of assemblages, etc., and the temporary increase of hospital facilities. "Our influenza was like a prairie fire—short and drastic. Every influenza patient was either convalescent or dead within five days from the onset of the attack." Exact knowledge is wanting as regards the sequelae of the epidemic, and an after-survey was undertaken, follow-up cards being distributed to every influenza victim under an appropriation by the city authorities. The field work occupied about two months, and the results are shown in tabulated form. On the first examination 748 cases were found reporting after-effects—501 have since recovered, and 216 are reported as recovering. Four deaths have occurred, but whether they were due to the after-effects or not is hard to say. Only 1 death out of the 4 was caused by tuberculosis. There were 220 cases of respiratory disorders, and 27 of these at least were tuberculosis. Out of the 27, 11 were already on their records as reported cases of tuberculosis before the influenza epidemic, and could not be charged to it. Only 8 cases could be positively diagnosed. Several were in families with tuberculous records. The first important observation is the small number of sequelae as compared with the total number of influenza cases, and the high percentage of recovery. It seems definitely established that there is nothing to be feared as regards tuberculosis as a sequel. The results also show the value of the early and vigorous measures employed for prevention.—*The Influenza Epidemic and Its After-Effects in the City of Buffalo: A Detailed Survey, F. C. Gram, J. Am. M. Ass., September 20, 1919, lxxiii, No. 12, 886.*

Relation of Influenza to Bronchitis and Tuberculosis.—The diagnosis of influenza is easy in epidemics with both bacteriological and clinical evidence, but very difficult when occurring endemically. Then the diagnosis must be made on clinical grounds for the most part, and identical symptoms may result from bacteria of several varieties and not from the influenza bacillus alone. An inquiry in regard to a history of influenza in 1058 tuberculous and non-tuberculous cases gave the following results: (1) In 416 cases of pulmonary tuberculosis, 112 began with an attack of influenza, 122 had one or more attacks of influenza after the onset of their disease, 30 were uncertain which came first. Of the remaining cases giving no history of influenza, 55 were early, 66 moderately advanced and 31 far advanced. (2) In non-tuberculous cases, there were: 62 chronic bronchitis beginning with influenza, 306 chronic bronchitis with influenza during their course; 3 fibrosis of one lung beginning with influenza; 7 morbus cordis with attacks of influenza; 19 bronchitis with enlarged tonsils or adenoids and attacks of influenza; 245 of chronic bronchitis without history of influenza.

In the majority of cases in group I, the so-called influenza was probably not influenza at all, but tuberculosis, and the activating organism the tubercle bacillus. Other organisms are frequently present in the sputum of tuberculous patients, and may be involved in the causation of "influenzal" attacks in these patients. The diagnosis of influenza should not be made unless in the presence of an epidemic, or unless the bacillus influenzae can be isolated in pure culture from the sputum. One ought to be sure that pulmonary tuberculosis has been excluded, otherwise the early stage of tuberculosis will be frequently overlooked.—*The Relation of Influenza to Bronchitis and Tuberculosis, J. A. O'Reilly, Long Island M. J., May 1919, xiii, No. 5, 122.*

Carcinoma of the Testicle Mistaken for Tuberculosis.—The differential diagnosis between carcinoma and tuberculosis of the testicle is generally easy considering the rarity of the former in comparison with the frequency of the latter. Besides, in the majority of cases of tuberculosis the diagnosis can be clinched by finding deep vesiculo-prostatic lesions. Nevertheless, an error is possible as shown by the following case: A soldier, thirty-four years of age, giving a history of injury to the testicle while in the saddle, was admitted with swelling of the testicle and hydrocele, the latter having recurred after tapping. Two distinct swellings could be made out, the lower one hard and the upper one surrounded by fluid. They were both painless. Along the vas deferens could be felt two small nodular swellings, the prostate seemed normal, the seminal vesicles could not be felt, and the urinary apparatus was not disturbed. The general health of the patient was below par. A diagnosis of tuberculosis of the testicle was made and the patient advised of the necessity of removal of the testicle, which he agreed to. The error was discovered at operation. The lower tumor was a sclerocystic-chondromatous degeneration of the whole testicle, while above and independent of the testicle was found a multilobular tumor which proved to be carcinoma.—*Sur quelques difficultés de diagnostic entre le cancer et la tuberculose du testicule, F. Cathelin, Progr. Méd., February 1, 1919, No. 5, 40.*

Anisocoria Due to Apical Pleuritis in Syphilitics.—Inequality of the pupils in a subject exhibiting definite indications of syphilis is generally accepted as an unfavorable prognostic sign, suggesting early involvement of the nerve centres and tabes or general paralysis. Yet anisocoria in the syphilitic may be completely independent of central nervous involvement; it is often caused by the apical pleuritis associated with a more or less torpid, fibrotic, sclerosing pulmonary tuberculosis. In such instances it is due to excitation or paralysis of the pupillodilator fibres which pass into the first dorsal and the third cervical ganglion through the *rami communicantes*. Not infrequently a stage of dilatation of the pupil on the same side, due to excitation, is succeeded by one of contraction resulting from destruction of the pupillodilator fibres. Lung tuberculosis is very frequent in syphilitics, and is especially likely in these patients to assume the fibrotic type. In fact, fibroid tuberculosis should be thought of as a definite diagnostic sign where indications of syphilis are being looked for. Fibroid pleurisy at the apex occurs in the majority of cases of tuberculosis in syphilitics. In most of these, again, there is enlargement of the supraclavicular lymphatics, symptomatic of the apical pleuritis or apical pleuropulmonary sclerosis. Finally, in some there is present in addition the unilateral pupillary dilatation or contraction referred to.—*L'inégalité pupillaire par pleurite du sommet chez les syphilitiques, M. Sergent, Bull. d. l'Acad. d. Méd., March 11, 1914, lxxxi, No. 10, 284.*

Treatment of Syphilis in Tuberculous Patients.—Elliott presents the data in ten cases treated with arsphenamin. His observations lead him to conclude that mercury should be used with great care in tuberculous patients, that the deleterious effect is not immediate, but appears several months after the institution or administration of the drug. Therefore, arsphenamin seems to be the drug of choice in such cases, but should be given in small doses and at long intervals, inasmuch as the ordinary dosage accentuates active foci and is prone to cause a flare up in latent lesions.—*Treatment of Syphilis in Tuberculous Patients. J. A. Elliott, Am. J. Syph., April, 1919, iii, No. 2, 291.*

Tuberculosis Causing Disordered Heart-Action.—The subcutaneous tuberculin test was done by seven medical officers in 300 unselected cases of disordered action of the heart and the results are reported by MacIntyre. Positive reactions were obtained in 32 cases; negative reactions in 268 cases and local reactions only in 97 cases.—*Tuberculosis as a Causative Factor in Disordered Action of Heart, H. R. MacIntyre, Bull. Canad. Army Med. Corps, May, 1919, i, No. 8, 110.*

Pathogenic Pneumococci and Streptococci in the Sputum in Pulmonary Tuberculosis.—Since the streptococcus and the pneumococcus are highly pathogenic for mice, the authors injected the sputum of tuberculous cases into mice, cultured from the peritoneal fluid and compared results with those of previous experiments with direct cultural methods. The sputum of 57 definite cases of pulmonary tuberculosis was examined in this way; 29 far advanced, all but one open; 24 moderately advanced, all open; 4 incipient, 2 open. The results showed 33 per cent sputums negative; in the positive sputums pneumococci types III and IV predominated, some of type II; and a few (4 per cent) streptococcus hemolyticus and viridans were found. For purposes of comparison the saliva of 10 cases of pulmonary tuberculosis and of 21 normal individuals was examined in the same way.

There was very little difference in the sputum and saliva of tuberculous cases; 5 of the 10 cases were negative in both; in the positive cases pneumococcus of types III and IV predominated. The findings in the tuberculous cases differed little from the normal cases; they also corroborate previous results from direct culture methods, from which it was concluded that the organisms found in the sputum in pulmonary tuberculosis ordinarily play an insignificant part in the disease. In the lung these organisms in tuberculous as in non-tuberculous disease, indicate a condition of lowered resistance.—*Mouse Pathogenic Pneumococci and Streptococci in the Sputum in Pulmonary Tuberculosis, H. J. Corper and J. J. Enright, J. Infect. Dis., September, 1919, xxv, No. 3, 213.*

Fundamentals in Treatment.—The successful treatment of pulmonary tuberculosis depends upon the physician's accurate knowledge of the disease and of the patient, and upon the latter's thorough coöperation. The first essential step is to convince the patient that he has tuberculosis and that he is curable. The second essential step in active cases is to gain the patient's consent to go to a sanatorium or health resort, where he can have proper treatment, proper control and instruction in the right methods of living. The choice of the resort may depend on the circumstances or the preference of the patient. Climate is not so important as the kind of life the patient lives. One fundamental truth in treating the active stage is "rest in proportion to the severity and duration of the symptoms."—*Fundamentals in the Treatment of Pulmonary Tuberculosis, G. Wilson, Med. Clin. North. Am., May 1919, ii, No. 6, 1605.*

Instructions for Consumptives.—Huber's circular of instructions for the use of his tuberculous patients gives a list of the common symptoms of the disease and points out the modern methods of preventing and curing pulmonary tuberculosis. It lays special emphasis upon the important part the patient himself plays in the management and upon the proper disposal of sputum. A description of what is meant by rest and when it is indicated, the fresh air regimen and diet are also given. Coöperation with and obedience to the physician are counselled all the time.—*The Tuberculosis Regimen, J. B. Huber, Med. Rec., August 16, 1919, xcvi, No. 7, 278.*

Absolute Rest in the Treatment of Pulmonary Tuberculosis.—Schaefer emphasizes the great value of absolute rest in the treatment of pulmonary tuberculosis irrespective of its stage. The patient should be put to bed at once and kept there for four to six weeks, during which time he is allowed to arise only once daily for stools. If at the end of this period the temperature has not come down to normal the rest should be made more rigid, a commode or bedpan being substituted for lavatory permission. When this fails to bring the temperature to normal the rest should be made still more rigid, the patient not being allowed to feed himself or to talk. After the temperature has become normal—that is, never above 98.6° F. by mouth—the rest in bed should be continued for at least a month in early cases, for several months in moderately advanced cases, and as long as a year in severe cases. The rest treatment should be combined with full feeding and open air, and all adjuvant measures for resting the lung should be employed, such as pneumothorax, lying on firm pillows, etc. The principle upon which the use of such complete rest is based is that of aiding the formation of firm scar tissue on the lungs about the lesions. In the hands of the author rest in the forms outlined has given the most excellent results, even in cases regarded as almost hopeless.—*Absolute Rest in the Treatment of Pulmonary Tuberculosis, S. W. Schaefer, Colorado Med., July, 1919, xvi, No. 7, 174.*

Rest in Tuberculosis.—The term "rest" as applied to the treatment of tuberculosis should include mental relaxation as well as physical repose. The healing of tuberculosis practically resolves itself into, 1) a process of building up and making the patient strong, and keeping him so for a long time until he becomes master of the invading bacilli, and 2) a stimulation of the patient's specific defensive powers. While rest is usually indicated in the active stage of the disease it is well to remember that one cannot rely on the disappearance of the common symptoms as meaning that the disease is no longer active, nor is it necessary that they all be absent before the process is inactive. Under conditions favorable for healing changes continue to take place in the lung of patients suffering from early clinical tuberculosis for a period of one to two years. Rest should be employed until it is found that exercise will not cause a return or an increase in the clinical symptoms. Rest is also preferable until the breath sounds have assumed the harsh quality characteristic of scar formation. All patients are put to bed on entering the sanatorium. An endeavor is made to secure the maximum possible degree of mental relaxation. In milder cases he may be allowed to get up and wash or go to the toilet. When the time comes to put

the patient on exercise caution should guide each movement. He is first allowed to sit up in bed for five or ten minutes, increasing by five minutes each day. When he is able to sit up three hours he is ready to begin walking. The first day he is allowed to walk about fifty feet and this is very gradually increased until he is able to walk from one to ten miles, depending upon his individual strength. Those able to walk ten miles a day will usually stand a day's work, provided they begin by working only a few hours each day and increase the number of hours gradually.—*The Importance of Rest in the Treatment of Tuberculosis, F. M. Pottenger, N. York M. J., July 19, 1919, xc, No. 3, 89.*

Diet in Tuberculosis.—For the purposes of diet, pulmonary tuberculosis may be divided into three classes: (1) the afebrile cases with fair or good resistance, (2) the febrile cases still showing a fighting resistance, and (3) those cases whose resistance is gone and who are constantly getting worse. In all cases "stuffing" with milk, butter and eggs is to be avoided. Milk products are a useful part of the diet to bring up weight, but it is not always desirable to fatten a patient. In the first class of cases as a general rule the diet should be that to which the patient has been accustomed, plus extra meat; but if the ordinary diet has obvious flaws it should be adjusted and balanced, with due regard to the patient's habits and tastes. Nourishment should not be taken between meals—not even a glass of milk; the meals should be at regular intervals to allow the stomach to rest. The standard sanatorium diet provides three meals a day. The Brompton Hospital Diet includes also tea at 5 p.m., and allows a half a pint of milk before retiring. Patients should be allowed to eat as much as they will, but a minimum amount of fresh meat should be insisted on; fresh green vegetables must always have a place in the dietary; salads and fresh fruits are valuable; potatoes should always be cooked in the skins; cereals and milk, milk puddings, eggs, and bacon are included. Cocoa may be substituted for tea and coffee. Patients of the second class should also be given the full diet whenever they can retain and digest solid food. Every possible endeavor should be made to keep up the standard diet for these cases. If the diet must be changed it is desirable to keep as near to it as possible, substituting chicken, game and rabbit for meat. If the patient cannot take solid food, milk and the liquid milk and meat preparations must be used. The third class can be allowed to eat what they like; nothing can be done to cure them, and no restriction should be placed on their dietary. The patients may be trusted to abandon any diet "followed by pain or discomfort out of proportion to the pleasure derived from it."—*Diet in Tuberculosis and Pulmonary Disease, E. Pritchard, Practitioner, August 1919, 53, No. 2, 143.*

Occupation Therapy.—With regard to occupation therapy in tuberculosis it is possible to divide the tuberculous into four groups: (1) Those who show signs of the disease but few symptoms, who usually recover quickly, but who are difficult to impress with the necessity of sanatorium care. (2) Those showing signs and having symptoms sufficiently marked to feel that they are sick. (3) Those having extensive signs and symptoms, who have probably been treated for other ailments. They have a temperature of 101°, are desperately anxious to get well and therefore willing to coöperate. (4) The old chronics who come to the sanatorium as a last resort for treatment, or to die. Bed occupations may be beneficial to the first and second groups. A man of active mind who has been accustomed to doing many things may find it extremely difficult to coöperate with the requirement of absolute rest. Allowing such man for a part of the day to carry on some light employment or to read, mental rest will be afforded, and thus motor restlessness will be allayed with consequent greater physical rest. Those coming under the last two groups are better off, however, under complete rest. They are too sick to desire occupation. Each individual must be studied as an entity and measures prescribed which will bring about physical as well as mental rest and contentment.—*Occupation Therapy and Tuberculosis, W. R. Dunton, Jr., Med. Rec., June 7, 1919, xcv, No. 23, 941.*

Occupational Therapy.—Occupational therapy has proved itself of sufficient value to be included as a remedial agent of considerable importance in institutions for the treatment of tuberculosis. It must not be assumed that it will prove effective in all cases, nor that it is a simple task to install, organize and continue a model department of it. But 50 per cent of the rank and file of patients can be expected to participate in it and in about 5 per cent some very strikingly beneficial results will be obtained. Long lasting fever will sometimes fall to normal as result of this treatment. It can be prescribed frequently by the physician to curb the restlessness of fiery and temperamental patients. It is frequently educational along esthetic lines, thereby inciting a new cultural interest in the patient's life that might

well become an avocation. It may possess the element of surprise or stimulate mild rivalry between patients. It is within proper limits restful, because a change, and it helps to kill time. When a patient has improved to the point that he is able to exercise two hours a day, he is eligible for transfer and admission to the industrial sanatorium, provided that he has absorbed the knowledge of how to live properly and provided it is important for him to reduce expenses for treatment. The average cash earnings per patient per week were $12.04; the weekly cost of maintenance was between $10 and $12. Thus about 10 per cent of patients were able to support themselves during their treatment. The plans call for an expansion to the establishment of a residential occupational colony, a tuberculosis town.—*Occupational Therapy, B. T. Crane, Boston M. & S. J., July 17, 1919, cxxxi, No. 3, 63.*

Sanatorium Treatment and Military Service.—Details are given of 47 cases that had been under treatment at the Ayrshire Sanatorium and entered the British service during the war. Of these 28 had been in the sanatorium in 1913 or previous years, and had been engaged in their ordinary occupations for some time when the war broke out. Many of these cases were not very favorable, and in many symptoms had existed for prolonged periods before undergoing treatment. Fourteen had tubercle bacilli in the sputum on admission to the sanatorium, 1 reacted to tuberculin, and of those in whom bacilli were not found, 12 were in the second stage and 2 in the third. In the service 1 held a commission, another was offered a commission, 1 won the military medal, 1 was promoted on the field for valor, 2 were sergeants and 3 were corporals, 8 were wounded, 3 gassed, 1 buried alive. Five were still in the service and in good health at the time of the report; 22 were demobilized and working; 9 were demobilized and in good health; 2 could not be traced; 1 had been readmitted to the sanatorium; 3 were killed in the service; 5 died, 2 from influenza, 2 from tuberculosis, and 1 from an operation in the military hospital. One was discharged from the army on account of his heart condition, which was really due to excessive pulmonary fibrosis. Another had had caries of the spine but was on home service through the war, and has been working since. One was in the hospital several months supposed to have pneumonia, but he evidently had an acute attack of tuberculosis; he recovered and went back into service, and since demobilization is working at his trade. These cases indicate that those who have contracted tuberculosis are "worthy of a better fate than to be segregated," for there can be no worse place for an uncured tuberculous patient than the army in time of war.—*Sanatorium Treatment and Military Service, E. E. Prest, Lancet, August 9, 1919, No. 5006, 240.*

Hospitals for Tuberculosis.—Members of the medical profession know only too well the importance of having hospitals for observation of cases of tuberculosis and for watching the results of different forms of treatment, while the community at large feels the need most acutely of provision for those who are in the final stages of the disease and require nursing for months, or possibly for years. On the theory that the tubercle bacillus gains first access to the body at different stages of life, and that every case of pulmonary tuberculosis is a possible source of infection, it would be necessary to isolate and nurse every case until the patient recovered or died. But this is an impossibility at present; sufficient sanatoriums cannot be provided to care for all cases, and if every tuberculous subject in England was to be found and isolated "there would probably be such an upset socially and economically, that there would be a revolution." On theoretical grounds it is true human beings may infect one another through the respiratory tract, but that this is actually the usual mode of infection is difficult to prove. On the other hand postmortem examinations of children dying of some other disease have demonstrated that practically every child is infected with tubercle bacilli in early life; and that pulmonary tuberculosis in adult life is but a later development of an early infection, when for some cause or other the lung tissues prove non-resistant. On this theory the isolation of cases of pulmonary tuberculosis is not necessary. On the other hand there is special need for two types of hospitals; (1) the "observation hospital" to which patients giving symptoms of tuberculosis could come for further study of their case and advice and aid in providing proper treatment, including sanatorium care if necessary; and (2) institutions which may be called "Invalid Homes" where patients who are suffering from pulmonary tuberculosis may be treated and nursed until they are fit to earn their living, or until they die. Such institutions should be located in populous centres where those who are ill may be near their families. This plan would not interfere with the present plan of providing sanatoriums for the treatment of those cases to which it is best adapted.—*Hospitals for Treatment of Pulmonary and Other Forms of Tuberculosis, A National Need, H. B. Shaw, Brit. M. J., July 26, 1919, No. 3056, 97.*

Tuberculin.—Tuberculin neither contains immune bodies nor stimulates antibodies. In acute cases of open tuberculosis all the toxins produced by the tubercle bacilli are thrown into the circulation, and the adding of additional toxin will result disastrously. In chronic cases, the so called closed tuberculosis, where nature has walled off the lesion and toxins are not thrown into the circulation, minute doses of tuberculin will do no harm. It is plain that the formation of antibodies by the cellular system requires the presence of dead or living bacilli, and the action of the leucocytes and the stationary cells. In closed cases no dead bacilli can be picked up or devoured by the leucocytes, hence antigen is lacking. Minute doses of tuberculin may assist in the formation of antibodies which flood the circulation but which cannot reach the encapsulated bacilli to destroy them. If more tuberculin is added, a slow gradual breakdown occurs, the protective capsule is destroyed, and the patient is overwhelmed with toxin. Immune bodies are the product of the cellular system of the body, which includes the ductless glands, plus antigen. Therefore no type of tuberculin is of value. It has been proved beyond doubt that the injection of living or dead bacteria, in small doses and increasing until three or six injections have been given, will immunize an individual to the specific bacteria injected, as typhoid, smallpox, and other infections. But once the disease is established, this injection cannot cure. The only legitimate use for tuberculin is to test animals for tuberculosis.—*Tuberculin in Tuberculosis, M. Staller, N. York M. J., July 26, 1919, xc, No. 4, 148.*

Tuberculin Therapy in Children.—Seven cases of tuberculosis in children and adolescents are described, the ages ranging from six to nineteen years, in which tuberculin was given in small doses. Four of these cases were peritoneal tuberculosis, and three of these were brought under treatment within a few weeks of the appearance of ascites and the improvement was prompt and gratifying; the fourth case gave more trouble and took longer to recover. The cases all illustrate the benefit of small doses of tuberculin and the great importance of bringing the cases under treatment early; the necessity for versatility in selecting the form and dosage of the tuberculin; the desirability of using vaccines, lipovaccines and other modifications of tuberculin, as well as the "accessories" such as sera and organic extracts. Advantage frequently follows a change in the form of tuberculin. It is "worse than useless" to reason out a priori what particular technique and dosage should be adopted for any patient or series of patients. These and other cases in the author's experience lead to the conclusion that children are, generally speaking, more susceptible to tuberculin than adults, and that when the results are favorable they are more quickly and more permanently manifest.—*Some Practical Hints on Tuberculin Therapy in Children, R. C. Newton, Med. Rec., September, 1919, xcvi, No. 11, 459.*

Tuberculin Treatment of Asthma from Tuberculous Glands.—Asthma from tuberculous glands at the hilum or in its vicinity is more common than generally recognized. Tuberculous tracheobronchial glands are not likely to entail asthma except in children with an inherited taint. Tuberculin treatment modifies the asthma, and has cured it completely in a number of cases in his experience. The details of nine cases of the kind are given, showing the improvement not only of the asthma but also in the general condition.—*Tuberculin Treatment of Asthma from Tuberculous Glands, L. Velasco Blanco, Sem. Med., June 12, 1919, xxvi, No. 24.*

Tropical Treatment of Dry Pleurisy.—Cetrángolo reports several cases of pleurisy in which he applied the technic for making an artificial pneumothorax, thus injecting air directly into the focus of the disease. By insufflating 100 cc. of air in cases of plastic pleurisy, the pain and friction sounds subside, the distention stretching the adhesions. The pain is increased the first day, but then usually disappears completely. From one to three insufflations are made at weekly intervals, with progressive improvement. In some cases the air was medicated, that is, it was passed through cotton moistened with 2 per cent camphorated oil. One insufflation of 100 cc. of the camphorated air cured one man with severe pains in the shoulder, worse during repose and at night. The pain increased after the insufflation, but by the next day had vanished permanently. One man with tuberculous lesions in both lungs and intense pain in the right side was insufflated with 120 cc. of air. The pains grew worse for two days and then vanished completely. The author thinks that he is the first to apply topical medication to suspicious pleurisies with the artificial pneumothorax technic.—*Hacia la medicación topica de las pleuresias secas, A. Cetrángolo, Seman. Med., February 13, 1919, No. 7, 161.*

Induced Pneumoserosa in Treatment of Serofibrinous Pleurisy.—Weil has now a record of fifty cases of serofibrinous pleu-

risy in which he injected air, after evacuating the effusion, until the pressure was the same as before. This insured healing without sequelae in 82 per cent of the cases, and the failures were in cases with preëxisting adhesions or tuberculous lesions in adjoining organs. A complete success therefore can be realized only when the diaphragm is free, but in one case the diaphragm finally regained its full play after a year of treatment, with ten interventions. In 34 per cent, healing was complete in two or three months; in a few in less than a month. In a parallel series of 86 cases simply punctured, without attempting to induce the *pneumoséreuse*, only 16 per cent healed without disturbing sequelae. Of course tuberculous processes elsewhere interfere with complete healing.—*Traitement des pleurésies sérofibrineuses par la pneumoséreuse thérapeutique, M. P. Emile-Weil, Bull. d. l'Acad. d. Méd., June 24, 1919, lxxxi, No. 25, 846.*

Air or Oxygen Injections in Pleural Disorders.—Injections of air or oxygen into the pleural cavity give excellent results in hydrothorax and recurring pleural effusion. They can readily be administered by any practitioner by means of the simple device described. The trocar inserted for paracentesis is also used for the subsequent injection of air or oxygen. The special device consists merely of a short glass tube containing a little absorbent cotton and connected with a piece of rubber tubing 6 cm. long and of such size that it will slip readily over the shank of the trocar. The filtering tube may conveniently be sterilized in a test tube stopped with cotton, or, in an emergency, may be prepared extemporaneously with a little sterile cotton and a boiled tube. At the free end of the glass tube a rubber thermocautery bulb is slipped on, or, if oxygen is to be used, the outlet tube from a bag of oxygen gas. The amount of air or oxygen to be injected varies according to the amount of fluid withdrawn and the degree of chronicity of the effusion. Generally the volume of gas used is much less than the quantity of fluid recovered. The fact should be borne in mind that if pure oxygen is used it will soon be absorbed, while if air is injected, its nitrogen component will remain in the pleura indefinitely. As most rubber bulbs hold about thirty mils of air, any desired amount of gas can be injected by compressing the bulb the required number of times.—*Sur un dispositif simple pour injecter des quanitiés connues d'air ou d'oxygène filtré dans la plevre, A. Challamel, Bull. et Mém. d. l. Soc. Méd. d. Hôp., January 23, 1919, No. 1-2.*

Artificial Pneumothorax.—During the twenty-five centuries that have elapsed since Greek, and possibly Hindu, physicians cured tuberculosis by rest and a proper diet, at least two things of real value have been added to the treatment: more rest and more attention to the diet. The phthisiotherapeutist must be an optimist. Given suitable economic conditions that enable him to enforce his regimen of rest and diet, he can frequently make a favorable prognosis. Certainly few infectious diseases offer the body a greater opportunity for successful resistance than does tuberculosis. The wisdom of the policy of noninterference has become so generally recognized that we are today perhaps overcautious and too conservative in our judgment of procedures that savor of active intervention. Among these is the use of artificial pneumothorax. Developed as an adjunct of rest therapy, it offers, in its ideal utilization, the utmost that we can expect from absolute rest.

Aside from the reluctance to depart from the policy of letting well enough alone, there is an impression among many physicians that the procedure is dangerous. Untoward results, however, have been limited virtually to the cases in which too large amounts of gas have been injected at the early fillings. These larger amounts of gas have been given on the false assumption that if a little gas is good, more will be better. Forlanini himself, in his first publications, warned against the use of large amounts of gas. He limited the amount injected at any one sitting to from 100 to 300 cc., but the early advocates of his method in this country (Murphy) and in Germany (Brauer) used larger amounts with admittedly spectacular but occasionally unfortunate results.

Murphy, however, laid great emphasis on the use of artificial pneumothorax earlier in the course of the disease. Then its effect might be assumed to be curative rather than merely palliative, as is so frequently the case when used in tuberculous patients in the utterly hopeless terminal stages of the disease. There is much to justify this position. Since pleural adhesions are the chief factor in the nonsuccess of the method, we should seek to apply the pneumothorax at a time when such adhesions are likely to be less frequent. They are found commonly enough in the routine postmortem examination of bodies that present otherwise normal lung findings. In cases of tuberculosis, in which the rich lymphatic network of the visceral pleura is so often the site of early extension, fibrinous and fibrous adhesions can be taken for granted in practically every case. The earlier the pneumothorax

is attempted, the less likely it will be that adhesions will prove too extensive for favorable collapse therapy.

The end-results of treatment described by Beggs, Minor, Morris, and Kendall and Alexander, seem to warrant definite confidence in the usefulness of the method in cases that are advancing despite the ordinary regimen of rest and diet, and perhaps also in early cases in which, because of unfavorable economic conditions, we cannot be assured that the patient will have the advantage (or at least the maximum benefit) that are possible under the usual hygienic and upbuilding methods.

It has been found in actual practice that the theoretical advantages of collapse therapy are fulfilled to a large degree, even when we cannot be certain that we have attained a complete result. The relative bloodlessness and the stasis of the lymph currents of the collapsed lung are followed by a lessening of the toxemia because of the decrease in the absorption of toxic material; the chances for dissemination of the infection are diminished; the rest accelerates cicatrization. To be weighed against these advantages is the possibility of activating a dormant focus of the opposite lung on which the entire task of ventilation is imposed. In hemorrhage, occasionally in lung abscess, and in some cases of bronchiectasis, ordinary contraindications must frequently be disregarded in view of the mechanical benefits of immediate compression and the relief thereby gained.

Artificial pneumothorax is today a relatively safe procedure. With gas injected under aseptic precautions, controlled by the roentgen ray and the manometer, and given in the small amounts insisted on by every conscientious worker, few complications need be feared. At present the method is seldom used except by the specialist in the tuberculosis field. The vast majority of tuberculous patients, however, are treated not by specialists but by the general practitioner, and there is no valid reason why a safe remedial measure should be withheld from the patient, who not infrequently is seen at a time when the pleural conditions are still favorable for the successful use of the pneumothorax.

If soldiers can be kept on active duty with a pneumothorax that is refilled at definite intervals, as they have been in the French army, there is no reason why, in times of peace, we cannot keep many patients in active, normal life and gaining a livelihood at their usual occupation. Under such conditions we are more likely, also, to keep the lung compressed for a longer period of time than if the patient is treated for a relatively short term at some institution and returns then to his former environment without further supervision. Keeping in mind the fact that collapse therapy is really rest therapy, Morris has well emphasized that it is much safer to keep a lung compressed too long than not long enough.—*Artificial Pneumothorax, Editorial, J. Am. M. Ass., September 6, 1919, lxxiii, No. 10, 769.*

Artificial Pneumothorax.—Artificial pneumothorax is not a routine method of treatment of pulmonary tuberculosis in whatever stage. It is indispensable in treating certain selected cases which do not respond to the routine sanatorium treatment, and in serious cases of hemoptysis. Only 21 patients received the treatment during the three years 1911–14. Two of these were in the incipient stage, 10 were moderately advanced and 9 far advanced. The results have been such as could not have been obtained without this method. Fourteen or two-thirds were benefited and 7 were not improved. In cases of hemoptysis the results have been gratifying. Absolute rest in bed during the early weeks of the treatment is essential in order to increase the resistance of the patient and to enable him to take care of the extra function called forth from the uncollapsed lung, the absorption from the collapsing lung, and displacement of the heart. No bad effects have been noted during the treatment and with proper consideration of the technique as regards asepsis, thorough anesthetization of the subcutaneous tissues and pleura, and regulation of interval between doses, the amount and temperature of the gas, and the rapidity with which it is introduced, the dangers may be greatly overcome.—*The Value of Artificial Pneumothorax Therapy as Associate Treatment of Pulmonary Tuberculosis, L. A. Alley, Boston M. & S. J., June 12, 1919, clxxx, No. 24, 668.*

Artificial Pneumothorax.—Between August 1910 and December 1916, 21 patients with severe pulmonary tuberculosis had pneumothorax induced artificially except in one case. The one exception had developed a spontaneous hydropneumothorax, which was converted into a controlled pneumothorax. Eleven of the 21 are alive and all but 2 of these enjoying good health and following their usual vocations. Nearly all of the 10 who died had their symptoms alleviated and their lives materially prolonged. Every case in the series had tubercle bacilli in the sputum, and in nearly every case a situation had been reached that was quite hopeless without the artificial pneumothorax. During the same period an attempt was made to

induce pneumothorax in six cases in which it failed completely on account of adhesions; and ineffective partial pneumothorax was induced in seven other cases. All but one of these patients are dead; the one living does not enjoy good health and cannot follow his occupation. From the experience in these cases the author draws the following conclusions: (a) In the earlier stages of the treatment, up to about 18 months, there is greater likelihood of injecting the gas too seldom, and making the pressures too high than of erring in the opposite direction. (b) The abandonment of the injections of gas in a successful case after too short a period is a far worse error than the continuance of refills too long. (c) It is by no means an invariable rule for the pleural surfaces to become adherent after the injections have been given up. (d) Every endeavor should be made to keep the pneumothorax cavity a closed one; the only exception is in the presence of secondary micro-organisms. (e) Those cases in which fluid developed at any time in the course of the treatment need special care. In these cases there is commonly some interference with the spacing of the injections of gas; fluid generally tends to keep intrapleural pressures up; and it is more likely to be followed by thickened pleura and adhesions. Hence it is customary to keep pressures rather higher in such cases. In considering the results of pneumothorax it is surprising to see how small the visible deformity of the chest is. Little difference is observable in some cases on casual inspection; in others only a very slight inclination to the "barrel-shaped" type of thorax. In many cases, however, the ribs come very close together by degrees, and in most the inflated side of the thorax is partly filled by displaced mediastinal and subdiaphragmatic organs, such displacements being more common on the left side than on the right. An artificial pneumothorax if effective should be kept up for at least three years. Under the following circumstances it should be kept up for at least four and a half years: (1) if the patient is over 33 years and has lost the resilience and recuperative powers of youth; (2) if the compressed lung was a fairly useless one before beginning treatment and was producing chronic poisoning; (3) if things are going well during the maintenance of compression. Compression may have to be maintained indefinitely in some cases, in others it may have to be abandoned prematurely; occasionally the treatment has to be abandoned after a long time, because it is found to be very difficult, or impossible, to continue it. No hard-and-fast rules can be laid down respecting the spacing of doses in the late stages of treatment, nor respecting the pressures. Low pressure readings are important, because before starting the refill preparations for the low negative pressure must be made.—*The Effects of Artificial Pneumothorax, S. V. Pearson, Lancet, July 26, 1919, No. 5004, 148.*

Treatment of Pulmonary Tuberculosis in Children by Artificial Pneumothorax.—Stolkind reports seven cases. The ideal case for artificial pneumothorax is one of advanced pulmonary tuberculosis or the so called second or third stage, with destructive or ulcerative one-sided disease, in which the other lung is, clinically at least, normal. Such typical cases of advanced and progressive pulmonary tuberculosis, in which only one lung is diseased and the other clinically healthy, are rare. In the majority of cases it is found that the other lung is also diseased more or less. In such cases pneumothorax treatment is employed if the disease in the other lung is inactive or chronic and quiescent. If extensive chronic lesions in both lungs are found, pneumothorax must be performed in the most diseased lung first. Afterward, if it is necessary and there is considerable improvement, the gas can be allowed to become absorbed or it may be pumped out, and then a pneumothorax can be performed on the other lung. This treatment is also used in cases in which the disease is not much advanced or in the first stage of the process, in spite of proper treatment by other means, advances and especially if it progresses rapidly, or if there are symptoms of toxemia. As there is at present no sure means of stopping hemorrhage, pneumothorax is indicated in cases with recurrent hemoptysis, and if the hemorrhage is severe or cannot be otherwise arrested. The lung from which the bleeding comes should be recognized and completely compressed, for which purpose 2000 to 3000 cc. of gas are introduced. Another indication is in cases of acute and progressive disease or acute tuberculous pneumonia or bronchopneumonia. The other indication is pulmonary tuberculosis with effusion of either blood, serum or pus. In carcinomatous pleurisy artificial pneumothorax is beneficial in relieving the pain. Pleural adhesions are not a contra-indication, but may prevent the production of a pneumothorax or a complete collapse of the diseased lung. Pneumothorax treatment is contraindicated in cases of pulmonary tuberculosis complicated by other severe disease, such as affections of the circulatory system, liver, kidney or severe diabetes and emphysema. No more than 500 cc. should be introduced at one time

and radioscopy should be used as a guide, both as to the extent of the initial introduction and as to the necessity of a refill. In children anesthetics should be used when the treatment is given. The most frequent complications are subcutaneous emphysema and pleural effusions. The emphysema is harmless and disappears in a few days. The pleural effusions may appear at intervals ranging from weeks to months after introducing the gas. It is mostly due to infection which is chiefly tuberculous. The improvement which is often observed in phthisis after the occurrence of pleural effusion is due not only to better rest and immobilization of the compressed lung, but probably also to the serobiological influence of the exudate, which contains many antibodies or hemolytic and bactericidal complements.—*The Treatment of Pulmonary Tuberculosis in Children by Artificial Pneumothorax. E. Stolkind, Brit. J. Child. Dis., January–March 1919, Nos. 181–183, 116.*

Effects of Roentgen Ray on Tubercle Bacilli.—Nine guinea pigs were injected subcutaneously in the left inguinal region with the filtrate from the livers and spleens of two advancedly tuberculous animals. Four days later, before there was any sign of local glandular involvement, two of the pigs were rayed over the region of inoculation, the rest of the body being covered by a ¼ inch lead plate. For one, the dosage was 50 milliampere minutes with a 9-inch spark gap at a distance of 8 inches, for the other 25 milliampere minutes under the same conditions. Filters were used to prevent burning. The two animals developed local tuberculosis as rapidly as the controls. Five of the other seven animals were rayed after marked local glandular enlargements had developed. Two were rayed 25 milliampere minutes, two 30, one 50, and one 75. Thirteen days later all the pigs were killed, the glands ground with sterile saline solution, and the fluid injected into nine other pigs. In all cases, tuberculosis was produced in the second set of animals. Roentgen rays in human dosage neither prevent the development of experimental glandular tuberculosis, nor destroy the organisms in fully developed lesions.—*Some Effects of Roentgen Rays on Certain Bacteria. M. W. Perry, Am. J. Roentgenol., September 1919, No. 9, 464.*

X-Ray Treatment in Tuberculous Arthritis.—The benefits obtainable from the X-ray in tuberculous joint disease are not sufficiently appreciated. Three cases are reported involving, respectively, the ankle, elbow, and vertebrae, in which apparent recovery followed their use. In the spinal case, the fourth and fifth lumbar vertebrae had been curetted two months before the author was consulted, but the wound had not healed and the infection had extended to several different points in the lumbar region. The X-rays were directed over the whole region every fortnight for three months, when treatment was interrupted by a severe attack of influenza. Three months after the interruption, when the patient returned, the wound and all the sinuses but one had closed, and the latter healed three months later. Treatment was kept up at longer intervals for several months, and no recurrence took place. In the elbow case, the area had been curetted three times in the course of five years, yet fungous tissue recurred. X-ray exposures every twelve days resulted in recovery in two months, and the results have now been maintained six years.—*Traitement des arthrites tuberculeuses par la radiothérapie, A. Briton, Presse Méd., June 12, 1919, No. 33, 320.*

Heliotherapy School.—Last year Armand-Delille organized a sun bath school, like Rollier's at Leysin, for the children of repatriated tuberculous women. The school was in a hilly region in Savoie, and every pleasant day forty or fifty children, dressed only in trunks, held school out of doors. They returned to the school building for lunch, and on rainy days the children were dressed and stayed under a shelter. The classes alternated with games and gymnastic exercises, and the children were thus engaged from 8 till 4.30. By the end of a month the favorable influence was evident, and by the end of three or four months the physical transformation was complete. The suspicious glands could no longer be felt. Similar results were obtained at the Sylvabelle station (Var) with 125 repatriate children who took sun baths without clothing all winter long. These experiences were on a scale large enough to fully confirm the necessity for heliotherapy as an integral element in outdoor schools. He does not hesitate even to declare that a course of preventive heliotherapy should form part of the hygiene for every child. It can be easily arranged on this principle of the sunlight school Of course medical supervision is necessary, particularly as a course of sun baths may be dangerous with pulmonary tuberculosis on account of the congestive reactions which it may induce. With this reserve, preventive heliotherapy is a powerful means for fortifying the organism, and is es-

pecially effectual in treatment of localized tuberculous lesions in glands.—*Heliothérapie préventive de la tuberculose chez l'enfant. L'école au soleil, Armand-Délille, Bull. de l'Acad. d. Méd., June 24, 1919, lxxxi, No. 25, 840.*

Injections of Cherry-Laurel Water in Chronic Bronchitis and Pulmonary Tuberculosis.—The benefit observed from selenium and copper salts in tuberculosis is due largely to the cyanide radical with which the metals are usually combined. Benzoyl cyanide in oily solution gives better results than the metallic cyanides. More recently Grimberg has been using the official French cherry-laurel water, which contains about 1 mgm. of free hydrocyanic acid in every mil of solution. Experimentation on the lower animals showed that the preparation is relatively but slightly toxic. Symptoms of poisoning did not appear until a dose of 0.2 mil per kilogram of animal was reached. The heart continued beating a long period after respiration had ceased, and elimination of the poison was very rapid. Clinically intramuscular and intravenous injections were used in about twenty cases, and the present paper is in the nature of a preliminary report. The intravenous injections seemed to yield more rapid results. The injections were given twice daily, with a dose of one mil. No local reactions followed. In cases with hemoptysis some caution is necessary in employing the treatment; in cases with fever no rise in temperature was ever induced. Improvement appeared after six to eight injections, the symptoms being relieved in the following order: dyspnea, cough, anorexia, and insomnia. Patients with fibroid tuberculosis seemed to experience the most relief from the treatment. Chronic bronchitis, whether tuberculous or nontuberculous, was regularly improved. In some instances a notable gain in weight followed. Generally the temperature was reduced, though only after about twelve injections.—*Traitement des bronchites chroniques et de la tuberculose pulmonaire par l'injection d'eau distillée de laurier-cérise, A. Grimberg, Paris Méd., February 8, 1919, No. 6, 125.*

The Inhalation Treatment in Pulmonary Tuberculosis.—Frequently the tubercle bacillus enters the body during the prenatal period of the individual. Ninety per cent of all phthisis has its inception in utero. The other 10 per cent may have contracted the infection. The mere entrance of the bacilli into the tissues does not produce phthisis. Most of the bacilli that enter the body are quickly destroyed the moment they come into contact with the blood of the individual. The bacillus of Koch cannot live long in live human blood. If the bacillus after entering the system multiplies, it is a sure sign that somewhere in the body it has found a bloodless area. Anemia is a prime requisite for the future existence, multiplication and propagation of this germ. Anything that will prevent anemia will prevent phthisis. The prevention of anemia is the only real, natural physiologic system of prophylaxis. After phthisis has occurred the conditions have changed. The bacillus by itself is quite harmless, billions could and perhaps do invade the body of the average human being. The bacilli themselves have never killed anybody. It is a certain toxic substance, the result of the metabolic processes, that does the poisoning. The metabolism of the bacillus cannot take place without a preëxisting anemic area. In order to insure the continued existence of the bacillus, it furnishes the toxic material which in turn causes a localized blanching; hence the anemia. All the antiseptics, creosote, camphor, phenol, gomenol, iodoform and turpentine, when inhaled in a volatilized state enter with the air current. There is no doubt that such a medicated air mixes with the blood and that it is carried to all parts of the body. All of these antiseptics are foreign to the physiology of the economy. Since they are foreign bodies the system reacts to them. If this reaction is one of generalized hyperemia it is at least logical to account for the prompt general improvement, increased appetite, gain in weight, etc. In other words, the antiseptics as such play but minor parts, but the reaction to such an irritant, when inhaled for an hour daily, may remove the first requisite, namely, the anemia. When the anemia is thus overcome, bacilli fail to multiply, the protein toxic element emanating from the germ is no longer produced, hence corresponding improvement in the condition of the patient. Geyser has demonstrated that blood, normal blood, and plenty of it in the lungs leads to a recovery where recovery is still possible. If diathermia is applied to the regions of the lungs for one hour or more daily, the patient put upon a suitable diet, rich in lime salts, proper rest and hygiene are carried out, many cases of phthisis will make a permanent recovery.—*A Few Derogatory Remarks Concerning the Inhalation Treatment in Pulmonary Tuberculosis, A. C. Geyser, West. M. Times, May 1919, xxxviii, No. 11.*

Tincture of Iodine in Tuberculosis.—Ritter strongly advocates the administration of tincture of iodine in tuberculosis, erysipelas, and other infectious diseases. He attributes its beneficial action in tuberculosis to the production of lymphocytosis with a

resultant fat splitting element which dissolves and breaks up the tubercle bacillus, which is of a fatty nature. The vehicle of choice is milk, beginning with one drop of tincture of iodine in a half glass of milk at the first meal, two at the second, three at the third, and so on until a dose of twenty or thirty drops is reached.—*Tincture of Iodine in Intensive Doses in the Treatment of Tuberculosis, J. Ritter, Ill. M. J., June 1919, xxxv, No. 12.*

Operative Treatment of Tuberculosis of the Larynx.—In six years 575 cases of laryngeal tuberculosis were treated at Davos, Switzerland. 1548 operations were performed: 61 times curetting only, 168 times both curetting and cauterization, and 1319 times electro-cauterisation. In every case there was an accompanying pulmonary tuberculosis, usually of the third degree and stationary. In 39 cases the pulmonary lesion was unilateral, in 25 on the right, and in 14 on the left. In the 25 right sided patients only the right side of the larynx was affected in 5 cases; only the left side in 4 cases. Of the 14 left-sided cases, the left side of the larynx was affected in one case, the right in two cases. In 259 cases the laryngitis was limited to a circumscribed focus and was stationary; in 265 cases there were multiple but limited foci without a tendency to rapid progression; and in 59 cases there were diffused foci with rapid progression and caseation. The tuberculous lesions were situated most frequently on the vocal cords. In summarizing the results, 154 cases which could be traced for a month or less are eliminated, and also 34 serious cases which were operated only to relieve suffering. In the remaining 387 cases, of 180 in the first stage, 89 or 49.4 per cent were cured; of 192 in the second stage 48 or 25 per cent were cured; of 15 in the third stage 2 or 13.3 per cent were cured. The best results (52 per cent of cures) were obtained by electro-cauterization of the cords. These results indicate that tuberculosis of the larynx can be cured. A considerable proportion of cases where the laryngeal symptoms did not improve under treatment which did improve the pulmonary condition, were cured by operation. Operative treatment of tuberculosis of the larynx should be undertaken only in cases where there is no fever and the pulmonary condition is stationary, except where urgent symptoms demand interference. The best method is electro-cauterization (Mermod-Siebenmann's method) with its broad and deeply destructive radical effect. Only in tuberculosis of the epiglottis was curetting more effective. Operative treatment in several instances exercised a favorable influence on the lungs and the general condition. The experience at Davos proves that high altitude is not contraindicated in tuberculosis of the larynx.—*Observations on the Operative Treatment of Tuberculosis of the Larynx, T. Ruedi, Brit. M. J., June 21, 1919, No. 3051, 764.*

Radical Operation for Genital Tuberculosis.—Advanced genital tuberculosis is so prevalent and such a progressive affection that any method, however radical, which offers a chance of recovery, is worth serious consideration. The operation found suitable for the removal of all diseased tissue consists of the removal of the testicle through an incision extending into the inguinal region in the usual way. The cord is then freed from the surrounding tissues as far into the inguinal canal as possible and there clamped and cut off. The patient is then placed in the lithotomy position and a semilunar incision made with its convexity anteriorly, and extending between the tubera ischii. After dividing the central tendon of the perineum, the rectum is pushed backward and by blunt dissection, following the plane of the rectovesical fascia, a deep pyramidal shaped wound is made which gives easy access to the prostate and seminal vesicles. By pushing the finger up to the apex of this deep wound and by pushing down on the forceps, which have previously been clamped to the cut end of the vas deferens in the inguinal canal, it is possible to push this clamp through into the perineal wound, carrying the cord with it. By removing this anterior clamp and replacing it with another through the perineal wound it is possible to remove the entire vas and ampulla with the seminal vesicle on the same side, and the lateral lobe of the prostate. It is important not to perform the prostatectomy first. After the operation tuberculin therapy is instituted and the recovery which some of these patients make is marvelous. Patients showing the slightest lung involvement should be considered inoperable. Their operative wounds fail to heal and only add to their discomfort.—*Radical Operation for Genital Tuberculosis, G. S. Whiteside, Northwest Med., May 1919, xviii, No. 5, 83.*

Spine Graft in Pott's Disease.—The main idea of the Albee operation is that of fixation of the affected vertebrae with those above and those below by an autoplastic graft from the tibia; it is based upon the possibility of controlling all movements of a section of the vertebral column by immobilization of the spinous processes. The vertebral column is built up in such a way that there is no locking or automatic stabil-

ity in any position and the immobility of the joints depends entirely on muscular tone and balance. The operation tends to give (1) permanent immobility in the corrected position; (2) a greatly reduced period of confinement to bed; (3) a safeguard against recrudescence of the disease. It is of benefit in all cases of unhealed tuberculous disease of the vertebral bodies, where there are no contraindications. The latter are: tender age (before the third year), great activity of the disease, affection of the atlanto-occipital and atlanto-axial region, a discharging sinus, or other septic focus, and open abscesses. An unopened psoas or lumbar abscess is not a contraindication if it is not necessary to operate through the abscess.

As soon as the diagnosis of Pott's disease is made, a definite course of preoperative treatment is begun, consisting of: (1) splinting usually with the double Thomas frame, sometimes with plaster of Paris; (2) reduction of deformity where indicated by gradual means; (3) general treatment including good feeding, open air, warmth. The methods of splintage are described in detail for the following "regional groups:" (1) Mid dorsal, low dorsal, dorso-lumbar, high lumbar; (2) high dorsal, cervical; (3) low lumbar; (4) lumbo-sacral.

During the operation, the operating room and table should be kept warm; any movement of the spine should be prevented; hammering should be avoided except the few taps necessary for the conversion of the drill holes into transverse cuts in getting the graft from the tibia. Ether is preferred to chloroform as an anesthetic. After the operation treatment for shock is indicated for the first few hours. The first dressing is done four, seven or ten days after operation, depending on indications for early dressing such as discomfort, sharp bony prominences, or poor nutrition of the skin. For the dressing the cuirass is specially indicated; the arrangement of the protective padding round the graft areas being done by the surgeon. This padding must be thick and so arranged that the weight is off the entire operation area. The patient is turned about once a week. In all cases of group 1 where a strong graft can be firmly placed and where the angulation is not great the frame is changed for a light spinal support (Jones') at the end of three months; the patient is kept in bed for another month and given massage, then sits up in a chair and is soon able to walk. The support is worn for a year. In the other groups light plaster jackets are used. In younger children, where the graft is not so strong, and in cases where the spine is short or angulation marked, six months or more in bed are required, the spinal support is kept on more than a year and removed only gradually under supervision. A table of 50 cases is given.—*Pott's Disease and Albee's Spinal Graft, G. R. Girdlestone, J. Orthrop. Surg., July 1919, xvii, No. 7, 401.*

Thoracoplastic Operations for Pulmonary Tuberculosis.—Saugman reviews the experiences in this line at the Vejlefjord Sanatorium, a total of twenty-six operations in the last two or three years. The indications for the operation were about the same as for artificial pneumothorax; in fact, this had been attempted in every case beforehand. Local anesthesia is very important, and it is astonishing to witness the patient's indifference to the extensive operation. One patient began to converse on some trivial subject in the midst of the operation. Large amounts of the anesthetic are required to block the nerves, and one girl of eighteen, in good condition, died soon after the operation. It had been hastened on account of her collapse, so that the resection of five ribs and the suturing took only fourteen minutes; 190 cc. of a 0.5 solution of procain (novocain) had been used in this case, after a preliminary injection of 0.015 morphin an hour before the operation. She had also been given a little sedative the evening before. Necropsy failed to explain the cause of death. In another case, signs of intolerance were evident from the first, and the attempt to use local anesthesia was abandoned. The local anesthesia does away with the danger of aspiration of secretions and the whole procedure is much easier for the patient. In one case an abscess in the lung was cleared out, after resection of three ribs, the patient sitting erect in a chair all the time. The total length of the ribs removed ranged from 80.5 to 172 cm., with 134 cm. as the average. There did not seem to be any advantage from including the eleventh rib in the resection. The pains after the operation seemed to be less severe in the cases in which the ribs had been resected subperiosteally. For this reason, operating in two sittings has its advantages. The after-care is extremely important, to ward off aspiration of mucus into the sound lung, and to give stimulants for the heart in case it shows signs of weakening. The thorax sank in after resection of the ribs, so that the chest on that side was only a half or third of the size of the other half of the chest, as was determined at necropsy in one case with death seventeen days after the operation. Twelve of eighteen patients apparently lost the tubercle bacilli completely from the sputum in the course of a few months. In two or three cases recurring hemoptysis called for the operation, but in

another case fatal hemoptysis occurred the seventeenth day after the operation. Possibly in this case the reduced ability to cough up the blood may have contributed to the fatal outcome, as the hemorrhage had been small. In the other case, pulmonary embolism the second day was responsible.—*Erfaringer fra Hejelfjord Sanatorium om Thorakoplastik ved Lungetuberkulose, Chr. Saugman, Ugeskr. f. Laeger, April 3, 1919, No. 14, 585.*

Endothelial Leukocytosis in Tuberculous Guinea-Pigs.—The percentage of endothelial leukocytes in normal guinea-pig blood varies considerably, as it does in human blood; in fifteen animals, the average was 1.58 per cent, the figures varying from 0.5 to 3.1 per cent. A leukocytosis may be produced by infectious agents or by chemical substances. In these experiments synthetic dyes were used, and it was found that Sudan III in large doses produces quite regularly an increase above the maximum of 3.1 per cent met with in normal guinea-pigs; in no case was an increase to 10 per cent noted. In the later stages of tuberculosis in guinea-pigs "induced in the usual way" the percentage of leukocytes found in the experiments with Sudan III is quite regularly exceeded, and this leukocytosis persists until the animal's death. The increase may appear within two weeks of the inoculation. In eight counts on six tuberculous animals, an average of 10 per cent of endothelial leukocytes was found; in one animal the figure reached 16.3 per cent. This form of leukocytosis is not noted as occurring in human subjects with tuberculosis, although it is apparently typical of the usual experimental tuberculosis of guinea-pigs.—*An Experimental Endothelial Leukocytosis in Guinea-Pigs, F. A. McJunkin and A. G. Charlton, Arch. Int. Med., September 1919, xxiv, No. 3, 295.*

Tuberculosis in Mice.—Experimental studies led to the following conclusions: (1) White and grey mice and white rats are less resistant against subcutaneous inoculation of tuberculosis than is generally admitted. (2) The experimental lesions are slow to develop, hardly manifest themselves, are sometimes only recognizable by microscopic examination and are almost always localized in the lungs. (3) The tuberculous virus does not lose any virulence by passing through mice, but seems even to gain. (4) A certain strain of bacilli retains its characteristics even after several passages through mice. (5) The infected animals can disseminate tubercle bacilli with their excreta. (6) In view of the slow evolution of experimental tuberculosis in rats, and in view of the conservation of the typical characteristics of the inoculated virus, these rodents could be advantageously employed in laboratories for the conservation of a given strain, thereby effecting a saving of animals. (7) For diagnostic purposes, however, mice and rats could not take the place of guinea-pigs just on account of the slow development of the infection. (8) For the differentiation of the human and bovine type, rabbits are far superior to rodents.—*Etudes sur les actinomycetes. Recherches expérimentales sur la tuberculose des muridés. B. Galli-Valerio, Corr. Bl. f. Schweiz. Aerzte, August 28, 1919, xlix, No. 35, 1309.*

Effect of Thorium X on Anaphylaxis in the Guinea-Pig.—It has been suggested that the greater part of the difference between tuberculosis in children and in adults, as well as the difference between chronic and miliary tuberculosis, is to be explained on the basis of the allergic condition of the patient. It was thought that if the allergic condition in guinea-pigs could be reduced, such animals would show marked differences in their reactions as compared with allergic animals not thus treated. Thorium X was used in the experiments, administered in a 0.9 per cent sodium chloride solution. Three separate protein mixtures were used for producing anaphylaxis—egg white, normal horse serum and milk. The results showed that thorium X given in about one-half the lethal amount seven days before or coincident with the primary injection of any of the proteins, or seven days before or coincident with the second injection had no appreciable effect on the severity of the anaphylactic symptoms in guinea-pigs on reinjection of protein sixteen to eighteen days after the primary injection. Likewise the repeated injections of smaller doses of thorium X sufficient to maintain a leukopenia as low as 2000 leukocytes per cubic millimeter throughout the entire interval of sixteen to eighteen days between the first and second protein injections or very small repeated injections not sufficient to affect the number of peripheral leukocytes perceptibly, had just as little effect on the severity of the anaphylactic symptoms. This method therefore proved impractical for the study of allergy in tuberculosis. These results do not agree with previous experiments on the effect of the roentgen ray and benzene on anaphylaxis, and indicate the need of further study.—*Effect of Thorium on Active Anaphylaxis in the Guinea-pig, H. J. Corper, J. Infect. Dis., September, 1919, xxv, No. 3, 248.*

Test of Recovery from Pulmonary Tuberculosis.—It is not as yet possible to make certain of recovery from phthisis by clinical procedures of examination, however carefully conducted. Complete disappearance of tubercle bacilli from the sputum for a period of at least one year is, of course, the initial test. Negative guinea-pig inoculation and albumin reaction should be obtained. Complete absence of expectoration is not to be expected, as expectoration free from tubercle bacilli may result from fibroid changes or bronchitis. The tuberculin test should be carried out, but not relied upon too much. The X-rays, while they permit of following out local improvement, do not definitely reveal complete recovery, as a scar alone will give a shadow. The body weight and blood pressure should have remained unchanged for some time at reasonably high figures. Absence of temperature rise after any amount of muscular exercise is another necessary condition. Prolonged absence of all adventitious sounds during deep inspiration after cough is an important indication, especially upon auscultation in the outer portion of the infraclavicular fossa, at the anterior margin of the trapezius. When all these indications have remained favorable for twelve to fifteen months, the author, in order to make a definite decision as to recovery, which would permit of the patient's resuming all usual social relations, applied what he terms "the test of progressive adaptation to activity." This test covers three months, and consists in having the patient work, at first for a few hours, morning or afternoon, on alternate days, then for a gradually increasing number of hours, morning, afternoon and evening. During the first two months rest days are interspersed with diminishing frequency. In the third month, no rest days are given. Throughout the test period the patient's weight, temperature, blood pressure, and auscultatory signs are recorded at regular intervals. Any rise in temperature, cough, increase of expectoration, or râles below the clavicle on inspiration rendered the test negative. The author has been using the test for seventeen years. In two thirds of the patients who passed the test successfully, health was subsequently maintained for periods ranging up to seventeen years. The test is best made in the late summer and fall months.—*Une épreuve de guérison de la tuberculose pulmonaire, L. Renon, Bull. d. l'Acad. d. Méd., June 3, 1919, lxxxi, No. 22, 761.*

Prophylactic Vaccination of Tuberculosis.—The vaccine used is the sensitized bacillary emulsion prepared with the avirulent strain obtained by cultivating the common virulent tubercle bacilli in a medium containing trypoflavin. The emulsion contains, besides the sensitized bacilli, a certain amount of the filtrated fluid of erythrodin broth medium. It, therefore, consists of the whole antigen of tubercle bacillus. Good results are claimed for this procedure.—*Prophylactic Vaccination of Tuberculosis, K. Shiga, Japan Med. World, May 11, 1919.*

Vaccination in Prophylaxis of Tuberculosis.—To Ferrán the tubercle bacillus is only the third phase in the life of the microorganism responsible for tuberculosis. His later research has confirmed him more and more in his views and in the efficacy of vaccination based on them. The first stage of the microörganism he calls the alpha stage. The bacillus then is merely an ordinary nontoxic saprophyte, but under certain conditions it induces phlegmasia and even galloping consumption but without tubercle production and without true tubercle bacilli. The second stage of the microörganism corresponds to Much's granules, and the third stage is the true tubercle bacillus. The importance of this conception lies in the fact that by a vaccine prepared against the first phase, the nonacid resisting alpha bacillus, the system is immunized against it and thus the whole chain is broken up and it does not progress to the other stages. It is easy to cure this phase of pretuberculosis by the alpha bacillus vaccine, but once the second or third phase is reached and the true tubercle bacillus installed, vaccine treatment is impotent. Castroman reiterates that the hopes based on tuberculin treatment of this phase have not been realized in practice.—*Nueva ciencia antituberculosa, M. R. Castromán, Seman. Med., May 15, 1919, No. 26, 507.*

THE

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ABSTRACTS OF TUBERCULOSIS

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Abstracts of Tuberculosis ***will be published at intervals as an integral part of the*** **American Review of Tuberculosis.** ***It will receive separate paging and may, if desired, be bound separately at the completion of the volume.***

The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page.

Remineralization in Tuberculous Coxitis.—Maragliano comments on the need for minerals when a tuberculous coxitis is healing. Besides the usual general measures, he supplies material for new bone directly to the process. The distance from the great trochanter to the bottom of the acetabulum is measured under the roentgen rays, and a corresponding rod of bone and periosteum is cut from the crest of the tibia, about 1 cm. thick. This bar is worked through the neck and head from the trochanter, after a passage has been dug for it, till the end emerges in the acetabulum. The porous condition of the bone renders this easy. It is important to have the periosteum project about 1 cm. beyond the end of the bar of bone. This end is turned down over the bone which prevents the periosteum from being stripped off from the bar as it is worked into place. He has thus operated in four cases, and the results of this slight operation to ensure remineralization of the joint bones have been very favorable.—*La Remineralizzazione Chirurgica Delle Coxiti Tubercolare. D. Maragliano, Rif. Med., April 12, 1919, xxxv, No. 15, 292.*

Why Tuberculous Persons Without Funds Should Not Leave Home.—The Denver Antituberculosis Society sends us the following contribution: It is reliably estimated that several hundred tuberculous persons without funds come to Denver every year. Practically all of them have the mistaken idea that climate will cure tuberculosis. Since Colorado has no state, and Denver no municipal tuberculosis sanatorium—but merely a ward at the County Hospital for thirty-five very sick tuberculous residents, the care of such indigent persons is limited to a few free private sanatoria, which are continuously so overtaxed that admittance is a long and difficult matter. These sanatoria comprise the two Jewish, which accept only a small number of Gentiles, a tent colony with a capacity for seventy "down-and-outers," and a small home for a dozen destitute tuberculous women. The tuberculous poor who migrate to Denver, finding no place where they can be cared for, look for light work, in order to maintain themselves and often their dependent families; but the demand for such work is far in excess of the supply. Driven to any work they can get, with neither friends nor care, anxious, homesick, hopeless, they rapidly grow worse, and, usually, soon die. They die for lack of proper rest, food, fresh air, and medical attention, the essentials of treatment, which many of them could have had at home—or here with sufficient funds, for two years' care. Without these essentials climate is of no avail. If it were, Denver would welcome these tragic health seekers instead of urging them, for their own

best chances, to stay at home. Denver also urges that the states throughout the country plan definite programs to retain their indigent tuberculous, giving them effective treatment in state sanatoria or in their own homes. —*Weekly Bull. Dept of Health, City of New York, November, 1919, viii, No. 44.*

Tuberculosis in New York City.—Notwithstanding the return of soldiers from the war and of many civilians from employment in war industries in other cities, our tuberculosis registration continues to be markedly low; in fact it is so low as to occasion suspicion that this is due in no small degree to the relaxation of efforts in various antituberculosis activities conducted in previous years by non-departmental as well as departmental agencies. In view of the continued high mortality rate from tuberculosis, one may, with reason, doubt that tuberculosis is actually becoming less prevalent. At all events, we are not justified in assuming this to be so until by careful and intensive effort, we further stimulate the discovery of cases by private physicians and clinics, and also work to secure the report of all cases by private physicians. As evidence of the diminishing number of cases of tuberculosis recorded with the Department of Health, attention is called to the following quarterly report:

Tuberculosis

Quarters Ending June 30, 1918 and 1919

		MANHATTAN	BRONX	BROOKLYN	QUEENS	RICHMOND	CITY
Population	1918	2,731,731	622,555	2,023,170	392,966	101,721	5,872,143
	1919	2,780,485	645,894	2,070,539	406,236	103,640	6,006,794
New cases reported	1918	2,631	478	1,428	178	42	4,757
	1919	2,256	463	1,025	145	56	3,945
Total cases in register	1918	19,379	3,324	7,828	1,563	260	32,354
	1919	17,138	3,366	6,977	1,460	279	29,220
New patients examined at clinic	1918	1,952	591	1,575	212	20	4,350
	1919	1,868	491	1,553	216	19	4,147
Total visits of patients to clinic	1918	11,715	3,983	8,179	1,741	154	25,722
	1919	10,170	3,297	6,862	1,612	193	22,134
Cases under supervision	1918	229	171	506	7	4	917
	1919	151	161	368	2	5	687
Voluntary renovations	1918	1,426	193	907	125	40	2,691
	1919	450	138	481	72	35	1,176
Sputum examined	1918	8,226	1,770	3,641	606	96	14,339
	1919	6,065	1,538	2,719	489	106	10,917
Sputums positive	1918	1,817	333	827	163	23	3,163
	1919	1,647	282	667	117	26	2,739
Deaths, pulmonary tuberculosis	1918	1,145	231	679	151	40	2,246
	1919	1,012	278	562	115	36	2,003
Deaths, pulmonary tuberculosis, per 1000 population	1918	1.69	1.49	1.35	1.54	1.58	1.53
	1919	1.46	1.73	1.09	1.14	1.39	1.34
Deaths, all forms of tuberculosis	1918	1,318	275	802	183	48	2,626
	1919	1,183	302	653	134	41	2,313
Deaths, all forms of tuberculosis, per 1000 population	1918	1.94	1.77	1.59	1.87	1.89	1.79
	1919	1.71	1.88	1.27	1.32	1.59	1.55

—*Weekly Bull., Dept. of Health, City of N. Y., October 18, 1919, No. 42.*

Tuberculosis in Health Resorts for the Tuberculous.—The fear of infection from contact with tuberculous patients is still widely prevalent among the laity. This phthisiophobia has often presented an obstacle to the institution of desired relief measures in the management of the tuberculous. The "fear born of ignorance" is not directed to these unfortunates alone. Even today it is frequently a difficult task to secure a suitable site for any contagious disease hospital in the vicinity of human habitations. The dread with which such an institution is still contemplated cannot be dispelled by exhortations or governmental edicts. The absence of special dangers in the environment of hygienically managed sick persons must be demonstrated in ways that will bring conviction to those capable of independent reasoning. The experience of a community frequented by tuberculous individuals who live with and among other residents, with no attempt at segregation of the sick from the well, ought to contribute convincing data. A survey recently made of the indigenous incidence of tuberculosis at Saranac Lake in the Adirondacks affords a striking illustration. This settlement has grown from small beginnings in the pioneer days of the late Dr. E. L. Trudeau into a health resort of prominence for patients afflicted with tuberculosis, especially of the pulmonary type. About one-fifth of the total population of several thousand persons is made up of individuals who went to live at Saranac Lake for their health. According to the statistics gathered in 1917 by Ames, under a fellowship grant of the Trudeau Foundation, the indigenous morbidity and mortality from tuberculosis were low, only 0.3 per cent of living cases being found among the native born and 0.9 per cent among previously healthy residents. The few facts on record for European health resorts likewise indicate that tuberculosis does not increase among the native population after tuberculous patients reside in a community, despite the assumption that a concentration of infectious foci might increase the occurrence of clinical manifestations of the disease even in the presence of better hygienic surroundings. The health resorts of Colorado are not regarded as a menace to the residents. From the consensus of evidence, Ames ventures the logical conclusion that there is a minimum of danger of infection of healthy adult residents of resorts frequented by tuberculous patients. In harmony with this finding is the attitude of the inhabitants. Fear is absent. Education through observation and experience has dispelled phthisiophobia. The tuberculous person in such enlightened communities is free from the stigma that so often is a barrier to his progress, even after health has been restored.—*Editorial, J. A. M. A., October 25, 1919, xxxiii, No. 17, 1288.*

Community Machinery for the Discovery of Tuberculosis.—Up to the present time communities with hospital facilities, clinics, tuberculosis nurses, and some educational service have considered themselves equipped for tuberculosis work; but this equipment does not provide for the discovery of new cases of tuberculosis. This is essentially a medical job and requires medical machinery; it cannot be done by nurses. During the Health Demonstration in Framingham, Mass., "the first medical examination drive" disclosed approximately nine times as much tuberculosis as was found by the nurses, and this is a community where there was an excellent tuberculosis clinic and one of the best tuberculosis nurses in the State at the head of the nursing service. Since the Health Demonstration, Framingham has added to its antituberculosis work several new features, of which those of chief interest relate to measures for the discovery of tuberculosis. Previously adopted routine measures include: (1) reporting of cases by private physicians, the number of cases so reported having been increased since the Health Demonstration; (2) the Tuberculosis Dispensary, which has brought to light a certain number of cases. New routine measures have been established through: (1) medical work in the schools; (2) factory medical work, about half of the industrial workers being under full medical supervision and others under partial supervision; (3) establishment of infant clinics, pre-school work, summer camps for children and other medical examinations reaching an additional substantial portion of the population. Special measures include: (1) medical examination campaigns, or drives to carry on "wholesale" examinations on large sections of the population, instituted during the Health Demonstration. This work gave valuable data on the incidence of tuberculosis, and also aroused public interest, encouraged people to go to their own physicians for regular medical inspection, and created popular sentiment in favor of medical examination work in schools, factories and elsewhere; (2) expert consultation service, occupying the full time of one physician as expert consultant at the Framingham Health Station. His services are offered to all physicians, and the advantages of such a service made known to the general public. The consultations are largely on a free, but partly on a pay basis. This is one of the most important features of the Framingham plan. Its advantages may be briefly summarized as fol-

lows: (1) The presence of an expert consultant, working in coöperation with local physicians, serves in a measure as a post-graduate education offering opportunities similar to clinic, lecture and demonstration procedure. (2) This work tends to improve and standardize routine methods of diagnosis, classification and treatment. (3) It has been the means of increasing the amount of known tuberculosis under observation or treatment. (4) By removing in many cases the burden of diagnosis from local physicians, it encourages the discovery of early cases. (5) It encourages tuberculosis reporting. (6) It tends to improve methods of home treatment and increases the percentage of cases institutionalized, the consultant being equipped to advise regarding the best method of treatment. (7) It supplements the other medical, nursing and dispensary community machinery, and provides the primary discovering machinery essential to the efficiency of all the other measures.—*Community Machinery for the Discovery of Tuberculosis, D. B. Armstrong, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 255.*

Plan for Antituberculosis Organization.—A comprehensive program for fighting tuberculosis should include: Organization, Legislation, General Community Sanitation, Disease Detection, Disease Classification, Treatment, Subsequent Observation, Prevention and Education, Research and Demonstration. Each of these headings is subdivided in detail and forms a definitely arranged plan which may be adopted by a community in the fight against tuberculosis.—*A Community Tuberculosis Program, D. B. Armstrong, Bull. N. T. A., October, 1919, v, No. 13.*

Framingham Demonstration.—It has been found useful at Framingham to supplement the accepted N. T. A. classification of tuberculosis. The cases are divided into early, advanced, convalescent, arrested, apparently cured, dead. The "early" group is subdivided into incipient, early, moderately advanced. The last subgroup is frequently bacillary while the former two are not. The group "advanced" is also subdivided into rapid, slow, stationary. The importance of this is evident when the method of treatment is considered. The rapidly progressing case needs a rigid care while the stationary case may even be allowed to work. The group designated "convalescent" is to identify cases clinically uncertain between the active and arrested stages. The group "arrested" is subdivided into early and advanced to denote the prior condition of the patient, and is important for follow-up purposes.—*The Classification of Tuberculosis, D. B. Armstrong, Bull. N. T. A., July, 1919, v, No. 10.*

The Health Officer and Tuberculosis.—When a case of tuberculosis comes to the notice of the Health Officer repeated sputum examinations are made to decide whether the case is open or closed. Six consecutive negative results are required within a week or two before a case is designated as closed. Open cases are isolated at home, in a hospital or in a sanatorium; this isolation should be rigidly enforced. The closed case is advised in the manner thought best in the particular case and is closely watched. In the case of children, who seldom become open cases, the parents are advised to have them under proper treatment and away from school, though the latter measure is not compulsory. All the members of a family in which an open case had been discovered are examined, and often also others who came in contact with members of this family. While closed cases are sent to the sanatorium only after the routine formalities are gone through, open cases are immediately admitted. The sanatorium should be so designed that open cases do not mix with closed ones and with each other, at least while they are running a septic temperature. —*The Attitude of the Medical Officer of Health with Respect to Tuberculosis, H. W. Hill, Med. Ins. & Health Conserv., November, 1919, xxix, No. 2, 65.*

American Commission for Prevention of Tuberculosis in France.—Following a report by Dr. Biggs on tuberculosis in France, a commission to carry on a campaign of education was organized by the International Health Board, a part of the Rockefeller Foundation, in 1917. Further investigation showed that there were fewer cases of tuberculosis in the French army than had been feared, but a high mortality in the civilian population. The nervous strain of the war and the restrictions in diet tended to increase the incidence of the disease, while the institutions that had been established for treatment were used for military purposes. The chief work of the commission was to institute a campaign of propaganda and education, to offer ideas and plans for a comprehensive antituberculosis organization for the whole of France, and not to give aid to any special group of the population. For demonstration and instruction a system of tuberculosis dispensaries was established in each of two centers, —one in the 19th arondissement of Paris, a typical city district, one in department of Eure-et-Loire, a typical rural district. At

the Paris dispensaries 4689 patients were examined and 1529 found to be tuberculous; at the Eure-et-Loire dispensaries, 2184 were examined, and 673 found tuberculous. Treatment was provided in Red Cross sanatoria and municipal hospitals. Over 100 French nurses were instructed and trained in the treatment of tuberculosis at the Paris dispensaries, and sent out to the Eure-et-Loire demonstration centers and to organize dispensaries in other districts. The Bureau of Education and Propaganda distributed over two million pieces of literature and held public lectures, conferences, and exhibits in 141 cities and towns of ten departments. Dr. Bruns, secretary of the commission, made a large number of preliminary surveys in other departments, and by means of lectures and conferences initiated the organization of permanent departmental committees to carry on the work by establishing tuberculosis dispensaries and demonstration centers. A permanent American-French committee was organized for the study and discussion of important problems in the campaign against tuberculosis.—*Work of the American Commission for the Prevention of Tuberculosis in France, W. C. Klotz, Brit. J. Tuberc., July, 1919, xiii, No. 3, 112.*

Welsh National Memorial.—According to the report of the Welsh National Memorial Association presented on July 26, 1919, the work of the Association went on successfully during the war. At the end of July, 1914, the association had 87 hospital beds and 148 sanatorium beds; by 1919, the number of hospital beds was 473, the sanatorium beds, 594. In the year ending March 31, 1914, 8763 patients were examined; in the year ending March 31, 1919, 12,260. During the war more than 50,000 in all were examined: 11,402 had received treatment in hospitals and 6373 in sanatoriums. These numbers include more than 2500 discharged service men examined, and more than 1600 treated in hospitals and sanatoriums. A special section of the report deals with the principles and ideals for the organization of the campaign against tuberculosis.—*The Welsh National Memorial. Editorial, Lancet, September 27, 1919, No. 5013, 592.*

Primary Pulmonary Tuberculosis in Children.—The findings of eighty-four necropsies made on children up to 10 years of age are recorded. Sixteen (19.05 per cent) showed tuberculous lesions. The lung focus was found to be most often the size of a pea. Single lung foci were found on eight occasions. Two foci, apparently about the same age, were found in one case, and one case showed more than two foci, of which one, being cavernous, appeared decidedly older than the remainder. In the majority of cases the focus was caseous or fibrocaseous. In one case it was calcareous, in one case liquefying, and in one case there was cavitation. In all cases the lung focus was situated just beneath or involving the pleura. In the cases where only one lung focus was present it was situated in the left lower lobe in three cases, in the right upper lobe in two, in the left upper lobe in two, and in the right middle lobe in one. Tuberculosis of the mediastinal glands, other than acute miliary tuberculosis, was found in twelve cases. Tuberculous lesions of the intestines were found in four cases. Tuberculous mesenteric glands were present in seven cases. Bronchopneumonic changes in the lung tissue, due apparently to the direct spread from a tuberculous lesion, were found in three cases. Miliary tuberculosis was found in five cases where a lung focus was present, and in two cases where no lung focus could be found. From these findings it would, therefore, appear highly probable that tuberculosis of the mediastinal glands is secondary to a focus in the lungs, and, further, that the focus in the lung is primary and not secondary to a focus elsewhere.—*Primary Pulmonary Tuberculosis in Children, R. G. Canti, Quart. J. of M., October 1919, xiii, No. 49, 71.*

Tuberculin Skin Tests in Schoolchildren.—The author gives a number of large tables showing the response to the Pirquet test in 7969 schoolchildren. It was positive in 37.8 per cent of the 6978 in the public schools and in 33 per cent of the 991 in private schools.—*Tuberculin Skin Tests of Schoolchildren at Tronhjem, A. Arnfinsen, Norsk Mag. f. Laege vidensk., May 1919, lxxx, No. 5, 508.*

Tuberculosis and Accredited Herd Plan.—That tuberculosis can be eradicated is not a theory, but a fact. Demonstrations have been carried on in the District of Columbia, Virginia, and other States. There is a compulsory law in the District passed by Congress. In ten years the percentage of reactors has been reduced in all the herds from eighteen to a fraction of 1 per cent. Statistics show in New York State that in regularly tested herds the number of reactors has been reduced. It is seldom that a reactor is found in localities where milk ordinances are enforced. Compulsory physical examination of herds has also reduced the clinical cases.—*Tuberculosis and Accredited Herd Plan, L. B. Leonard, Cornell Veterinarian, July 1919, ix, No. 3, 163.*

The Intradermal Test in Cattle.—The chief advantages of the intracutaneous test over the subcutaneous test are the rapidity with which the cattle of a county or section of country can be tested; its accuracy, about 98 per cent of reactors having been shown to have lesions of the disease; the smaller amount of tuberculin used, the rapidity of the work and the convenience of the operator making the test much less expensive. With the subcutaneous test many outside factors may cause sufficient variation in the animal's temperature to render the test of little value. The intracutaneous test is not affected by these influences. In case of doubt after using the intracutaneous test the subcutaneous can still be resorted to; but after employing the latter the former is of little value. The imperative need of eradicating tuberculosis in swine makes this test desirable of employment in these animals, since the subcutaneous test is impracticable owing to difficulty of restraint and great variations in temperatures in hogs. The site of injection in swine is the skin on the back of the ear near the head.—*The Intradermal Tuberculin Test, C. Ackley, Am. J. Vet. Med., December, 1919, xiv, No. 12, 558.*

Tuberculin Re-test of Cattle.—The observations here recorded appear to support Gilliland's theory that if animals that had given a suspicious reaction were to receive five to ten days later a much larger dose they would give a strong reaction if tuberculous, and a negative result if nontuberculous. —*Subcutaneous Tuberculin Re-test of Cattle, D. H. Jones, J. Am. Vet. M. Ass., July, 1919, v, No. 4, 444.*

Generalized Tuberculosis of the Horse. —The animal was a gelding, eight years old. The autopsy report upon this animal shows that there was a fibrinous pleurisy; lymph glands were hemorrhagically swollen; otherwise the spleen and the lungs were the only organs affected, the latter showing evenly distributed lesions throughout their substance. From inoculation experiments on guinea pigs and rabbits, it appears that the tubercle bacillus in this case was of the bovine type. The source of the infection of this horse is not known, but inasmuch as this animal was stabled in a basement barn with cattle, it is quite probable that there has been a bovine spreader of the disease in the stable at some time, leaving the stable or feed contaminated with tubercle bacilli of the bovine type.—*Generalized Tuberculosis of the Horse, M. F. Barnes, J. Am. Vet. M. Ass., September 1919, v, No. 6, 672.*

Some Statistics of Tuberculosis.—Ménard deduces from his prolonged study of 225 tuberculous soldiers that the onset of tuberculosis may present a wide variety of types. The first sign that anything is wrong may be an *embarras gastrique*, neuralgic or rheumatic pains, functional heart disturbance, colds, bronchitis, febrile painful lassitude, etc. The remarkable fact is that having begun insidiously with symptoms of a certain order, it persists in exhibiting this same set of symptoms all through the other symptoms which may develop *en route.* There is then a long latent interval—six months, twenty months, thirty-eight months —after the appearance of the first symptoms before the disease manifests itself. Then it throws off its mask and develops openly. What are the reasons for this sudden transformation from the insidious form to this open manifestation? He suggests that this may represent the true problem of pulmonary tuberculosis.—*Statistique de tuberculose, P. J. Ménard, Ann. d. Med., August 1919, vi, No. 3, 223.*

Physical Reconstruction.—Physical reconstruction of soldiers disabled by pulmonary disease is a new policy originating with the present war. At first the plan had but few advocates, but modern medicine must take account of functional as well as physical restoration in the convalescent patient and establish it as nearly as possible. In the treatment of the tuberculous patient, the objections advanced to the above policy are sound in the sense of the application of the measure embraced under physical reconstruction during the active and febrile stage of the disease. On the other hand, when indicated, physical and mental rest, even to the most absolute degree practicable, is as much a factor in physical and mental rehabilitation as physiotherapy, curative work or play when rationally called for. Tuberculosis, as a rule, is a focal infection. The primary focus is usually started in childhood. Later in life the pathogenic lesion takes on an added virulence, or the tissues are less resistant, and the course of the disease depends on these factors. Unfortunately, however, the virulence in some cases is too strong to be met by the ordinary measures of rest, fresh air, feeding, etc. Mental unrest and discontent may appear even if the physical condition is improved. Rationally, we cannot prolong absolute rest beyond the active or febrile stage, and the dosage of mental and physical exercise next prescribed must be under watchful medical supervision. If the progress is favorable, bed-rest periods are shortened and the ambulatory stage with

such physiotherapy as hydrotherapy and massage and occupational therapy modified in kind and dosage to meet the need of the individual patient is taken up. Manual occupational therapy should be used as early as mental and physical activity admits. Billings goes into some detail on this subject. When the tuberculous soldier has reached the stage of arrest or inactivity of the disease he may be discharged, but the measures adopted in modified form in his earlier treatment may still be needed to a certain extent to prevent relapses. The results already obtained have been so beneficial that it is hoped that they can be continued in civil life and tried out under the direction of civil physicians. The almost universal testimony of the commanding officers of hospitals and the educational personnel agrees as to the great value of the work already done.—*Physical Reconstruction Applied in the Treatment of Pulmonary Tuberculosis, F. Billings, J. Am. M. Ass., October 4, 1919, lxxiii, No. 14, 1033.*

Rehabilitation of the Tuberculous Soldier.—There have been rejected for tuberculosis by the local draft boards, about 62,000; 23,000 more, by the camp surgeons; about 5000 have been discharged directly from the army and almost 2500 more from the army sanatoria; about 6000 tuberculous soldiers are now under treatment in the army sanatoria in this country and perhaps a few hundred overseas. The importance of the problem of tuberculosis in the army was recognized early in the war; boards of examiners were organized for special chest examinations for the purpose of discovering all cases of the disease and eliminating those unfit for service. Up to the early part of 1918 a great majority of the tuberculosis cases were discharged immediately from the army, but when the new special hospitals were ready it became the policy of the War Department to hold all soldiers said to be tuberculous until fit to return to duty, or until it was evident that no more benefit could be derived from further treatment. Because it was found that the men in the hospitals were not so amenable to discipline as in the camps, and that there was much restlessness and dissatisfaction among the patients, reconstruction departments were organized. The object of these departments was to carry out all medical therapeutic exercises, to keep the patients contented and as busy as their physical condition permitted, and to return them to civil life better fitted to compete with modern conditions. The work was started by the use of therapeutic walks arranged in a series of five, varying in length from two-thirds of a mile to three miles. Men, who were in proper condition after a period of hospital rest, were assigned to the first series, and promoted as their condition warranted through the entire series. Patients were dropped automatically if the temperature rose to 99 or above or if there was loss of weight. Later a carpenter shop, an auto school and a farm were established, and men were graduated from the therapeutic walks into these departments. Class work was organized in schedules that did not interfere with physical reconstruction work, and also for a few who were able to do light mental work, but not physical. A weekly newspaper was established, and picture shows given nearly every evening to patients in the wards. Instruction for patients confined to bed was provided in academic work, drawing and various forms of handicraft. The Otisville Hospital No. 8 reported that 75 per cent of all patients were engaged in some part of the work, and that for many months no person had been obliged to quit any of the outside work on account of increased tuberculous activity. One month's report of the New Haven Hospital No. 16 showed 90 per cent of the patients engaged in some part of the work. When a tuberculous soldier is discharged from the army, he is entitled to compensation, based on his reduced earning capacity. Advanced cases may be cared for at home or in local sanatoria. Those with active disease, but with good hope of recovery may be recommended by the War Risk Insurance Board to local sanatoria or to Public Service hospitals. When the disease is arrested, the soldier is entitled to the services of the Federal Board of Vocational Education to aid him in obtaining work in his former occupation; or, if this is entirely unsuitable, to give him retraining in some new line of work. Education is still necessary to impress upon the soldier and his family that it is not necessary for him to change his residence; that he is not permanently unable to work; and that he should not try to change his occupation unless the work or its necessary environments are positively harmful.—*The Rehabilitation of the Tuberculous Soldier, C. E. Perry, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 260.*

Rehabilitation of the Tuberculous Soldier.—When a man examined in the draft or a soldier found to have tuberculosis is sent home, the state department of health of his state is notified, this department notifying its district health officer, who in turn requests the local board of health, the local tuberculosis department, or other suitable local agency to look up the patient and see

that he receives proper attention. In Massachusetts, 2020 such men have been reported to the state board of health; only 25 of these have been sent to the four state sanatoria, and 30 more are in other hospitals. A study of 1512 of the men discharged shows that 1060 are in their home locality, 60 have left the State, 72 are dead, 156 nontuberculous, 96 have left their home locality, the fate of 68 is unknown. Of those in their home locality, 356 are under medical supervision, 573 have no medical supervision, 131 unknown; 271 are in good condition, 615 in poor condition, 174 condition not stated; 410 are working, 246 not working, 404 not stated. These figures indicate that there is need for improvement on the part of the local health organizations. Patients must be examined more often, and educated in regard to the communicability of the disease, and its curability if treatment is begun early enough. Patients without independent means of support should not be advised to go West to live; they can be taken care of in their home locality. The occupational therapy described by Perry is of the greatest importance in the work of rehabilitation after the patient leaves the sanatorium, and should be inaugurated in all institutions wherever possible, both for civilian and soldier patients.—*The Rehabilitation of the Tuberculous Soldier, S. H. Stone, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 265.*

Tuberculosis Problem After the War.—While tuberculosis as a result of the world war has not become as serious with us as with the European nations, a good deal remains to be done to further reduce the death rate and misery following in the wake of this disease and to enable us to be of help to the less fortunate and less prepared countries of Europe. Birth control for a number of years has been urged by some tuberculosis experts in England but in spite of this sound reasoning women will continue to bear children and many tuberculous women will still become mothers. While some of these tuberculous mothers may not survive, some of the children may, and it is the duty of the physician to endeavor to save these children together with those who have already contracted tuberculosis. Maternity sanatoria must be created. Tuberculosis dispensaries to act as clearing houses for all kinds of tuberculosis afflictions, and attached to them a corps of visiting nurses; preventoria, children's sanatoria, favorably situated sanatoria for the early cases, hospital sanatoria near the large centers of population for the more advanced cases; special institutions for post-sanatorium treatment, special sanitary workshops for training of invalids and ex-patients; colonies for those able and willing to pursue open-air occupations; and, lastly, open-air schools for tuberculous children and teachers constitute the chain of institutions which an enlightened community must provide in order to cope effectually with the tuberculosis problem. Marriages of tuberculous partners should be prevented. To this must be added the sanitary housing of the masses, industrial hygiene, and child-labor prevention. The duty devolves upon this nation to help and to enlighten the nations of Europe, which have faced starvation and poverty for five years, and to assist them to become happy and prosperous once more.—*The Tuberculosis Problem After the World War, S. A. Knopf, Med. Rec., July 26, 1919, xcvi, No. 4, 135.*

Tuberculosis in the Canadian Army.—The incidence of tuberculosis under conditions of army life did not prove as great as was anticipated; and, whereas before the war chief emphasis was laid on the frequency with which cases of tuberculosis were wrongly diagnosed as various other diseases, the experience gained during the war showed the need of emphasis in the other direction, the frequency with which other diseases are wrongly diagnosed as tuberculosis. The pre-war idea, that all that was required to properly handle the tuberculosis problem was unlimited authority backed by unlimited financial resources, was not supported by the results in the army, where these requisites were fully met. A primary essential for coordinating all antituberculosis measures and of reaping from them the greatest possible benefit is education of the general public with regard to the essential facts of the disease, the means necessary for its prevention and the principles of its successful treatment. Of 900 cases under observation, 28 per cent were classified on admission as incipient; 42 per cent moderately advanced; and 30 per cent far advanced. With regard to prognosis they were classed on admission as follows: 54 per cent favorable; 32 per cent less favorable; and 13 per cent unfavorable or hopeless.—*The Tuberculosis Problem under After-War Conditions with Reference to Canada, W. M. Hart, J. of State Med., November, 1919, xxvii, No. 11, 336.*

Army Tuberculosis Problem in Massachusetts.—According to the latest figures there were 1604 Massachusetts men rejected at the physical examination under the draft law or discharged from the army camps, on account of tuberculosis. An investigation as to the status of these men, covering all the cities and eleven of the largest towns,

(over 90 per cent of the total population) shows that out of 1566 men rejected by local draft boards, there are 548 concerning whom local authorities can give no information. One hundred and ten have died; of the remaining 622, whose status was known, 500, over 80 per cent, are working and in apparently good condition; 431 of these are under supervision; 28 are working and in poor condition; 43 are at various sanatoriums. Only 42 men were found who were discharged from the service on account of tuberculosis; 29 of these are under supervision, and 11 are in state sanatoriums. The tuberculosis problem in war time is not essentially different from that of peace. The wholesale examination of men under the draft law has brought to light many new cases of tuberculosis, latent or active, as any well-conducted survey would do. The men discharged from the army have been well taken care of in army sanatoriums or by the War Risk Insurance Bureau with the assistance of the Red Cross. Experience with the cases brought to light during the war has, however, emphasized certain phases of the tuberculosis problem. For instance, it has shown that local authorities do not have sufficient knowledge of the sanatorium and hospital facilities available for tuberculous patients, nor how to make use of them. The state should emphasize these facts in a bulletin published at least once a year. The figures quoted show that it is too easy for a man to escape all health supervision after he has been classified as tuberculous or as suspect. Local boards should make an annual survey of their communities, and give adequate accounting of the status of every case of tuberculosis. Another important point is to determine definitely how many of the cases classified as tuberculous or as suspect in the draft and in the Army have the disease in a clinical sense. The standards of diagnosis are, and should be, stricter for the Army than in civilian life; but the State, in studying these cases, and in future tuberculosis work, should formulate standards clearly, as to what constitutes active pulmonary tuberculosis from the state and board of health point of view.—*Army Tuberculosis Problem as Seen in Massachusetts, J. B. Hawes 2nd, Boston M. & S. J., October 23, 1919, cxxxi, No. 17, 499.*

Medical Notes on Pulmonary Tuberculosis.—Certain physiological differences between the two sides of the chest are frequent sources of error in the diagnosis of phthisis. The expansion and percussion resonance are relatively deficient over the upper lobe of the right lung, and the breath-sounds in the same situation may be bronchial in quality; this last sign particularly often leads to error. In well-established phthisis, the disease is more often bilateral than the physical signs indicate; the lesions also have probably been present longer than the history indicates. Skiagrams in cases of phthisis must always be interpreted in conjunction with the clinical features. When examination of the chest shows bronchial catarrh, any or all of the following signs indicate pulmonary tuberculosis: (1) signs largely or entirely unilateral; (2) signs more marked at the apex than at the base; (3) râles with the consonating quality; (4) constitutional symptoms disproportionate to the amount of catarrh. The final decision is based on the findings of the tubercle bacilli in the sputum. It is not common to find the physical signs of cavity, e.g., hyperresonant percussion note and cavernous breathing. Cavity is more frequently diagnosed by the knowledge that the disease is advanced and the sputum purulent and abundant. Tuberculosis of the lung anatomically shows three main types: (1) chronic caseating bronchopneumonia—the ordinary type; (2) acute caseous pneumonia; (3) acute miliary tuberculosis. Hemoptysis in an apparently healthy young man should be regarded as evidence of phthisis, and treatment instituted at once. Such early treatment usually results in a cure, in which case the patient may regard the diagnosis as wrong and the treatment as unnecessary. But if the hemoptysis is disregarded the disease is likely to advance, and the physician accused of neglect. Hemoptysis occurs at three different stages in phthisis: (1) early in the disease when the amount of blood is small, unaccompanied by sputum, it comes from the congested bronchi near the tuberculous focus; (2) during the course of a well-established case, when the hemorrhage is accompanied by cough, and often a slight fever, the blood comes from an ulcerated vessel in the wall of a cavity; (3) in an advanced case as a late event, hemorrhage large in amount, and often fatal, blood comes from a ruptured pulmonary aneurism lying in a cavity. The blood is not likely to contain tubercle bacilli, and should not be examined. The sputum should always be examined for the bacilli, no matter how "classical" the symptoms. In diabetes, cirrhosis of the liver, and leukaemia, the resistance to infection by the tubercle bacillus is so low that phthisis may be present in a latent fashion for some time without discovery. There is a decided family tendency to phthisis, as well as to particular types of phthisis; in one family hemoptysis may be common, in another fibrosis, etc. Although certain general principles of treatment are

well established, these general principles must be carefully adjusted to each individual case; not only the type of the disease but the patient's temperament must be considered. The intelligent coöperation of the patient is one of the essentials of success, and this should be fully explained at the beginning of the treatment.—*Medical Notes on Pulmonary Tuberculosis, T. Horder, Practitioner, September, 1919, ciii, No. 3, 176.*

Diagnosis of Early Pulmonary Tuberculosis.—Early tuberculosis is defined as that state in which there is an active disease in the lung but the constitutional condition has not become so much impaired that the patient may not recover. Tuberculin tests and the roentgen ray examination show that nearly every adult has been infected with tuberculosis but they do not indicate decisively whether the process is active or not. The general symptomatology is of much importance. Loss of weight, fatigue on comparatively slight exertion, increase in heart rate, low blood pressure, recurring fever, no matter how slight, secondary anemia, disturbed digestion, and cough indicate an active pulmonary tuberculosis. The cough may be slight or severe, but is persistent, with little expectoration, or with expectoration which is watery, mucoid, mucopurulent or hemorrhagic. In some cases there may be a sudden hemorrhage from the lung with only slight previous cough. The presence of tubercle bacilli and of elastic tissue in the sputum clinches the diagnosis. A positive tuberculin reaction indicates that the individual has been infected with tuberculosis, but it does not distinguish between an old long-healed lesion and an active one. Under the roentgen ray, the difference between active and healed lesions is very slight, showing a slight fuzziness of outline in the former, and a sharp outline of calcification in the latter. Percussion or palpation gives valuable information in regard to the changes in the lung, but does not indicate the duration or activity of the lesion. Auscultation gives more definite information, not so much from the respiratory sounds as from the râles. A shower of at least three fine moist râles on inspiration indicates a deposit of tubercle. If the râles are viscid to the ear, rather than watery or abundant, the process is more acute; if the tubercle begins to undergo caseous degeneration, small moist râles are present subcrepitant with inspiration and expiration, and crepitant only at the end of inspiration. Any pneumonia with fever persisting past the usual time for that type and not continuing to resolve makes imperative a careful examination for the presence of a tuberculous lesion.—*The Symptomatology and Diagnosis of Early Pulmonary Tuberculosis, T. A. McGoldrick, Long Island M. J., June 1919, xiii, No. 6, 175.*

Cracked Pot Sound.—Various methods of accounting for the cracked pot tympany are enumerated by Walsh, as well as the conditions in which it may occur. It is commonly thought that the larger a cavity in the lung and the nearer to the anterior wall, the more likelihood of its production. Yet we often see cavities of the largest size immediately underlying the surface not producing it. Large cavities apparently connecting freely with large bronchi without the sound having been produced are often found at necropsies. It is ordinarily said that the pathologic conditions required are a large cavity communicating freely with the bronchus and relaxed lung tissue. Walsh reports briefly a case which showed the cracked pot sound in the first interspace near the sternum on the left with dulness to the fourth interspace, December 1, 1918. December 5, it showed ordinary tympany in the first interspace and cracked pot sound in the third interspace $1\frac{1}{2}$ inches from the sternum. A diagnosis of two cavities was made. The roentgen ray, however, showed four cavities, two superimposed on two others. The possibility of the double cavity having some influence on production of cracked pot sound was suggested, and further cases were sought—only one was found. December 30, the first patient died. The necropsy disclosed not four, but three cavities, situated so that the first underlaid the second, and the second the third. The first extended from the apex to the second rib, the second from the first to the third rib, the third from the second interspace to the fourth rib. In other words, though only three cavities were present, they were so placed that in the two situations in which cracked pot sound occurred, there was a part of a cavity superimposed on another. On the strength of this finding, the conclusion was reached that the superimposing of cavities may, at least, aid in the production of cracked pot sound, and investigations were made by artificially introducing cavities into the removed lungs of animals. Percussion of two inflated bladders tied together so as to prevent the escape of air and placed one over the other gave tympany, but not cracked pot sound, and, therefore, the admission of air is necessary, and the mere rattling of cavities on each other is not sufficient to give the sound. An open trachea was percussed both within and without the lung and found to produce it, but not so typically

as occasionally heard. Two open tracheas, however, superimposed produced it exquisitely. These facts explain its occurrence in pneumonia and in crying children better than the usual one. It was never heard over a pneumothorax, though sought for in more than twenty cases. Stanton reports sixty-one cases without cracked pot sound. With the idea of superimposed cavities in mind we would expect it only over a small pneumothorax communicating freely with the lung with a large cavity behind it.—*Superimposed Cavities the Possible Cause of Cracked Pot Sound, J. Walsh, J. Am. M. Ass., November 29, 1919, lxxiii, No. 22, 1656.*

X-Ray Diagnosis of Cavities.—Saye, in a study of tuberculous cavities of the lung, divides them roentgenographically into the following groups: (1) The classical cavity, as described by Bouchard. (2) The giant lobar cavity, of frequent occurrence, mostly on the left side, and embracing an entire lobe. (2) Cavities in process of formation, characterized either by a continuous ring in a densely infiltrated zone or by a dark shadow fairly well circumscribed by a ring, and having within a group of small white or gray zones resembling the inside of a loaf of bread, or presenting a "honeycomb" appearance. (4) Abnormal cavity images, characterized by an irregular or sometimes broken border, mostly found in slightly infiltrated areas. (5) False cavity images, described by Schut and others as annular shadows within healthy lung tissue and with no fluid level. The presence of a fluid level is pathognomonic of cavity. DeCerenville has stated that unless the cavity attains the size of a walnut, unless it contains more air than liquid, or has smooth walls, or is surrounded by dense tissue, or is near the surface, or opens into a bronchus, it may escape detection by physical examination. These errors can be checked up and corrected by the X-ray, which in most cases portrays the size, location and character of the cavity.—*Examén Radiologico de las Cavernas Tuberculosas del Pulmon, L. Saye, Arch. Espan. d. Tisiologia, January 1919, i, No. 1, 105.*

Diurnal Variations of Body-Weight in Tuberculous Patients.—The observations were made on patients attending Stepney Green Tuberculosis Dispensary, Glasgow. Patients were weighed in the afternoon between 2 and 4 and again the next morning between 10 and 12, being instructed to wear exactly the same clothing at each examination. In the majority of cases there was a decrease in the morning weight as compared with that of the previous afternoon, varying from ½ pound to as much as 4 pounds. There were no changes in sleep or diet that could account for the variation. Out of a total of 962 recorded weights, 146 showed no variation, 205 showed an increase, and 611 showed a decrease. The average increase was 0.77 pound, the average decrease 1.03 pounds. Taking only positive cases, there were 55 that showed an increase, averaging 0.6 pound, while 150 suspect cases showed an increase, averaging 0.3 pounds. Of the positive cases 177 showed a decrease averaging 1.6 pound, as against 434 suspect cases averaging 0.8 pound. A table arranged according to ages shows the decrease to be greatest for the ages of twenty to twenty-four years. —*Diurnal Variation of Body-Weight in Tuberculous Patients, J. McM. Scott, Lancet, October 11, 1919, No. 5015, 639.*

Hemoptysis.—While the layman very generally identifies hemoptysis with tuberculosis of the lungs, the overwhelming majority of tuberculous patients do not show this symptom. Among 70 patients, 2 or 3 had occasional slight hemoptysis, and only 4 or 5 had bacilli in the sputum. Hemoptysis is not always of tuberculous origin; blood coming from the mouth may be from the fauces, posterior nares, decayed teeth, ulcers of the larynx, the stomach, or even the small intestines. Even if from the lungs, it does not necessarily indicate tuberculosis; it may be caused by severe cough or other strain, or may be due to pulmonary congestion from initial lesions, pneumonia in the initial stage, emphysema or asthma with chronic bronchitis, bronchiectasis, etc. Hemoptysis of tuberculous origin is of two types—bloody sputum, found in early cases especially, and profuse hemorrhage or pure blood, generally in later cases. The prognosis is favorable if the bleeding comes from a congested area; if from the rupture of an aneurism it usually proves fatal. These patients should be kept perfectly quiet; food should be given in small quantities, and drink restricted. Small pieces of ice may be held in the mouth, and an ice-bag applied to the chest. Morphin may be given, especially to control cough. In limited hemorrhage this treatment is usually sufficient. In profuse hemorrhage from a ruptured aneurysm treatment is usually unavailing; tying the limbs may serve to check the bleeding, and allow a thrombus to form.—*Hemoptysis, H. Rabinowitch, N. York M. J., September 6, 1919, cx, No. 10, 416.*

High Temperature in Tuberculosis.—Following an attack of measles and whooping cough, Johnson's patient, then 10 years of age, developed pulmonary tuberculosis. She was treated in a camp and was finally

discharged with the disease arrested. Three years later her temperature ran an irregular course for which no explanation could be given. She had no cough or physical signs of activity in her chest. The temperature began to reach 109° and 110°F., going up quickly though never remaining up for more than one or three hours. She did not complain much during these periods, except of headache. The sputum and urine were negative, also the blood, except for moderate leukocytosis. A roentgenogram of the chest showed considerable involvement of the right apex with a small cavity. A number of miliary tubercles were found on the left choroid (examination two years later failed to find any evidence of these). A diagnosis of acute miliary tuberculosis was made on the eye findings. At this time she was suffering with toothache, and an examination disclosed an abscess at the root of one of her teeth. The trouble was corrected, following which her temperature promptly dropped to normal.—*Case of Tuberculosis with Very High Temperature, G. C. Johnson, Ind. State M. Ass. J., October 15, 1919, xii No. 10, 262.*

Relations Between Luetin and Tuberculin Skin Reactions.—Blechmann has been comparing the responses to the luetin and the Pirquet skin tests in eighty children. He obtained a positive luetin reaction in from 30 to 35 per cent. of the children with inherited syphilis, but he also obtained a positive reaction in 40 per cent. of the children free from inherited syphilis. This suggests that the luetin reaction is not specific. His study of the subject seems to indicate that the luetin reaction is quite independent of that of tuberculin, and is rarely so well defined as the Pirquet reaction.—*La prétendue liaison allergique des cutiréactions à la luétine et à la tuberculine, G. Blechmann, Ann. d. Méd., August, 1919, vi, No. 3, 200.*

New Bacteriology of Tuberculosis.—According to what has been called the new bacteriology of tuberculosis of Ravetllat, three different forms of organisms are capable of producing tuberculosis. These have been designated A, B, and C. C is the tubercle bacillus discovered by Koch. Bacteriemia is not due to the bacillus of Koch but to the tuberculogenous bacterium A of Ravetllat.—*Transformacion in vitro del bacilo de Koch en bacteria tuberculogena, A. J. Ravetllat & R. Pla y Armengol. Tratamiento de la septicemia tuberculosa, R. Pla y Armengol. Septicemia tuberculosa. Tratamiento, A. Presta, Revista Hig. y Sanodad Pecuarias, Madrid, September, 1919, ix, No. 9. 547, 549, 560.*

Sedimentation of Tubercle Bacilli.—The following method was used in a large military chest hospital, and over 20 samples of sputum examined a day with its use. Five cubic centimeters of sputum are mixed with twice their volume of

Sodium carbonate (cryst.)	1
Acid carbolic (cryst.)	1
Water	100

in a centrifuge tube. The tube is covered, shaken for a few minutes, then incubated for twelve to twenty-four hours. At the end of that time, the tubes are centrifugalized for about fifteen minutes, the supernatant fluid poured off, and films made from 2 or 4 loopfuls of the deposit, stained in the usual way. The chief advantages of this method are: (1) its rapidity; (2) the sputa when taken out of the incubator are sterile; (3) the films resemble the direct smears in the relative proportion of other organisms present and in the presence of mononuclear and polymorphonuclear cells but the mucus is not stained; (4) in almost every case as many, or more, tubercle bacilli are found as with other less simple methods.—*Sedimentation of Tubercle Bacilli in Sputum, J. G. Greenfield & J. Anderson, Lancet, September 6, 1919, No. 5010, 423.*

Biologic Test for Active Tuberculosis.—Wildbolz made investigations during the last year and a half on more than 200 persons and demonstrated that when there is an active process of tuberculosis the urine contains an antigen which injected by the Mantoux intracutaneous technic induces infiltration and redness. This does not occur with urine from healthy persons or in urine from persons with healed tuberculous processes. It never occurs unless the person gives a positive response to injection of 1:10,000 tuberculin, but it seems to occur whether the urine is from the person being tested or not, so long as he has an active tuberculous process anywhere in the body, in glands, peritoneum, lung, bones or elsewhere. Wildbolz evaporates morning urine to 1:10, passes once or twice through a paper filter impregnated with 2 per cent phenol, and then makes three sets of two injections on the arm, the two upper with 1:1,000 tuberculin; 3 or 4 cm. below this, two with 1:10,000 tuberculin, and, the same distance below, two with a minute amount of the evaporated urine. The response with an active tuberculous process is the same with the urine as with the diluted tuberculin, but the tuberculin response persists unmodified after the process has healed, while the urine response fades out completely. A similar response was never obtained in the

nontuberculous, not even in syphilis, influenza, etc., with the single exception that urine containing large amounts of staphylococci induced a reaction, so that the findings are not pathognomonic in certain cases of nephritis. With this exception, this biologic reaction may be depended on to reveal the tuberculous or nontuberculous nature of lesions, and will also disclose when they are healed. If the urine reaction persists after the clinical healing of the known process we can be confident that there is some other active process elsewhere. The specific nature of the urine reaction is demonstrated still more conclusively by the fact that, after subsidence of the urine reaction, if an injection of 1:1,000 tuberculin is made nearby, the apparently extinct urine reaction flares up anew, the infiltration and redness becoming distinct again. This does not always occur, but it is frequent enough to testify to the specific nature of the urine reaction. He cites three cases of different types to show the reliability of the findings with this urine test. One, a boy of 13, had for over a year what seemed to be a tuberculous process in the ankle region, rebellious to all treatment. The roentgen findings were negative, the process being apparently in the soft parts. The urine test was negative, and the operation finally revealed a wood splinter in the depths of the fistula. In another case the positive urine reaction was not heeded as the diagnosis otherwise was so obscure, but necropsy revealed the grave tuberculous process in the kidney. In another, the course confirmed the urine test, namely, that the case was one of incipient pulmonary tuberculosis instead of congestive hemorrhages from uncompensated heart disease. By comparing the urine response with the response to the tuberculin test, we can obtain better insight than ever before on whether treatment must be kept up or the patient can be regarded as clinically cured. He repeatedly obtained a negative urine reaction in women nephrectomized a year or a year and a half before on account of isolated tuberculous processes in that kidney. He has never yet noted this rapid subsidence of the urine reaction in men after nephrectomy for this cause, and he assumes this to prove that there is still some lingering tuberculous process, possibly in the prostate or seminal vesicles. If repeated urine tests fail to give a positive response, year after year, we may accept this as evidence that the tuberculosis has been radically cured. He warns that patients being treated with tuberculin may give misleading findings as the tuberculin passing into the urine might induce the reaction. Wildbolz is now engaged in research on intracutaneous injection of other body fluids, the serum, pleural and joint effusions and cerebrospinal fluid, and with conjunctival reaction with the milk of tuberculous cows.—*Der biologische Nachweis aktiver Tuberkuloseherde des menschlichen Körpers durch die intrakutane Eigenharnreaktion, H. Wildbolz, Corr. Bl. f. Schweiz. Aerzte, May 31, 1919, xlix, No. 22, 793.*

Sputum Albumin Reaction in the Diagnosis of Tuberculosis.—Salomon calls attention to the marked diagnostic value of the sputum albumin test recommended by Roger and Lévy-Valensi in 1911. The sputum is collected freshly in a dry receptacle, an equal volume of distilled or tap water added, the fluid mixed with a glass rod, mucus coagulated by addition of acetic acid, the resulting fluid filtered through paper, and the filtrate tested for albumin by heat or the addition of potassium ferrocyanide solution. The author modifies the original method by mixing the fresh sputum with saturated sodium sulphate solution where heat is to be used as precipitant. In the ferrocyanide method he uses both the chemical and heat. The sputum is first mixed with 0.7 per cent sodium chloride solution, the mucin then precipitated with acetic acid, the liquid heated to boiling and a drop or two of saturated ferrocyanide solution added. A slight turbidity, devoid of significance, nearly always results; the test is considered positive where a marked precipitate forms and persists on boiling, the latter dissolving the albumoses that may have been precipitated by the ferrocyanide. In tests made in 404 patients, the reaction was never negative in cases with tubercle bacilli in the sputum. A repeatedly negative reaction therefore excludes tubercle bacillus excretion; where many cases are to be rapidly sorted out, the test permits of rapid separation of the uninfected from the infected. Coupled with X-ray examination, it also permits of discounting the significance of any suspicious rough breathing at the apex or exacerbation of apical pleuritis. The test is constantly positive in chronic lung tuberculosis, but is also often positive in nontuberculous acute inflammations of the lungs and in pulmonary congestion due to heart or kidney disease. It is not infrequently strongly positive in tuberculous cases in which the bacilli are difficult to find, and is very useful for the recognition of apical pleuritis, always agreeing in its results with those of the X-ray examination in such cases. In apical fibrosis, a negative reaction signifies that the lesions are healed, while a positive reaction means that the patient should be kept under observation.

In chronic bronchitis, the test is generally negative, and if persistently positive, careful examination for a tuberculous focus in some portion of the body should be made.—*La valeur d'albumino-réaction des crachets pour le dépistage des tuberculeux, M. Salomon, Presse Méd., September 18, 1919, No. 52, 523.*

Neutrophilic Index in Diagnosis of Tuberculosis.—Polymorphonuclear neutrophile leucocytes with two or more separate lobules, absolutely apart and not connected by an isthmus band, are more "matured" and are endowed with a better phagocytic and a greater antibody action than the polymorphonuclear neutrophile leucocytes with one lobule. In cases of tuberculosis where tuberculin is administered, Durel recalls there is always an increase of polymorphonuclear neutrophile leucocytes with one lobule after the injection of a "tonic" dose of tuberculin. This is generally followed in a few days by a corresponding increase of polymorphonuclear neutrophile leucocytes with two or more distinct and separate lobules. Cases where tuberculin reactions are frequently repeated always show a persistently high neutrophilic index, i.e., a high percentage of polymorphonuclear neutrophile leucocytes with one solid lobule. These cases also always show an increase of moisture over the tuberculous lesions. This increase of moisture is accounted for by the overcrowding of polymorphonuclear neutrophile leucocytes about the tuberculous foci, the pressure of the cells against each other producing a pneumonic serum exudate. The predominance of one lobule polymorphonuclear neutrophile leucocytes, associated with an increase of moisture (moist râles) over the tuberculous lesions, and following a reaction to tuberculin or severe exertion, clears up a doubtful condition often seen, but for which no tangible reason could be given nor accountable cause assigned.—*Neutrophilic Index and Administration of Tuberculin, W. J. Durel, South. M. J., September 1919, xxii, No. 9,* 517.

Complement Fixation.—A study of complement fixation in 466 cases, including 220 of proved or suspected pulmonary tuberculosis, is reported by Pritchard and Roderick. The clinical chest study by Pritchard consisted of a careful history, a physical and fluoroscopic examination with an interpretation of stereoscopic plates of the chest, three sputum tests and three days' pulse and temperature observation. The serologic study by Roderick consisted of a Wassermann test with both cholesterin and acetone antigens, and a complement fixation test with two antigens for tuberculosis. The work was done separately and charted before the roentgenographic interpretations were made and the laboratory tests were made without knowledge of the clinical study. The complement fixation was made in terms of +, ++, +++, and ++++, and all cases below +++ were considered negative. In attempting the study, the authors were hoping to find a new link in the chain of evidence of the existence of clinical tuberculosis, but no such reliable test as the Wassermann for syphilis was found, but it was still deemed that its usefulness as a routine test was shown. If the authors' observations have been reasonably accurate, and 69 per cent of active moderately advanced cases give a reaction compared with 16 per cent reacting in nonproved cases, they feel that the test is of value, but should not be relied on without additional evidence. A frank reaction calls for careful study of the case. They found no evidence of cross fixation with the Wassermann reaction. Recognizing the great prevalence of nontuberculous pulmonary pathologic conditions, they sought to ascertain the cause of the indisposition, rather than to prove its tuberculous nature. In some clearly advanced cases, no reaction occurred, which may be possibly explained by the cells having become exhausted by prolonged saturation with specific toxin. The Wassermann test should be made in all cases of suspected tuberculosis as the two diseases may be coincident. It is of greatest help in differential diagnosis and stimulates careful clinical observation.—*Complement Fixation Test for Tuberculosis, J. S. Pritchard and C. E. Roderick, J. Am. M. Ass., December 20, 1919, lxxiii, No. 25, 1879.*

The Polymorphism of Tuberculosis.—The disease in adults is the flaring up of infection acquired in childhood or reinfection after partial immunization. This flaring up or reinfection is announced by a set of disturbances and symptoms which are usually called "pretuberculosis" but which had better be called the "prerelapse of tuberculosis." It is wrong to say that tuberculosis is the most curable of diseases; the cure of tuberculosis is exceptional. But a first attack confers a relative immunity. To maintain this immunity the resisting powers must be kept at a high level. Tuberculosis cannot progress—in the adult at least—if the soil is unfavorable. Prophylaxis must combat weakening of the race and of the individual. Treatment must combat the bacillus (serotherapy), and tone up the organism until the soil becomes unfavorable (rest, fresh air, nourishing food and medica-

tion to restore minerals and especially calcium).—*Conditions pathogéniques et étiologiques du polymorphisme anatomo-clinique de la tuberculose humaine, E. Sergent, Bull. Méd., October 15, 1919, xxxiii, No. 44, 579.*

Conjugal Tuberculosis.—There is considerable difference of opinion in regard to the frequency of conjugal tuberculosis. Probably the most authoritative opinion is that conjugal infection is rare, and any increased incidence is attributed to predisposition and causes other than direct infection. The author as tuberculosis officer of South Devon has visited the homes of reported cases of tuberculosis and examined the patient and the contacts in the home. Out of 156 cases in which husband or wife was examined 91 (58 per cent) were found to be tuberculous, 16 (10 per cent) suspect, 49 (32 per cent) negative. Considering wives whose husbands were first reported, out of 120 cases, 66 (55 per cent) were tuberculous, 12 (10 per cent) suspect and 42 (35 per cent) negative. Among husbands of tuberculous wives, in 36 cases, 25 (69 per cent) are tuberculous, 4 (11 per cent) suspect, and 7 (20 per cent) negative. During the five year period in which the figures were collected, the tuberculous mate first reported has died in 15 cases, and in 7 cases both husband and wife have died. Comparing the results with contacts other than husband and wife, out of 1057 examined, 219 (20 per cent) were tuberculous, 284 (27 per cent) suspect, and 566 (53 per cent) negative. Considering the contacts of cases examined and found nontuberculous, out of 81 examined, 4 contacts (5 per cent) were tuberculous, 7 (8 per cent) suspect, and 70 (87 per cent) negative. A statistical study of this kind is open to many criticisms. However the figures have all been collected by one observer, and hence may be justly compared; they were collected in the course of everyday work and not for the purpose of proving or disproving any theory. After following up these cases, the author is convinced that the great majority of the mates of tuberlous husbands or wives do sooner or later show signs of tuberculosis, but also that the great majority of those infected recover, and recover more rapidly than ordinary tuberculous patients. This may be attributed to an enhanced immunity conferred by graduated doses of bacilli. Over 50 per cent of all cases of tuberculosis are due to direct personal infection, and for that reason highly infective cases should be isolated.—*Conjugal Tuberculosis, E. Ward, Lancet, October 4, 1919, No. 5814, 606.*

Postinfluenzal Tuberculosis.—Postinfluenzal tuberculosis is defined as a reactivation of an old tuberculous focus, following a more or less severe attack of influenza. A study of the mortality statistics during and following earlier epidemics and the epidemic of 1918–19 shows that epidemics of influenza are not followed by any measurable increase in the incidence of tuberculosis. To some extent the many pulmonary conditions resulting from the recent epidemic of influenza obscure the early diagnosis of tuberculosis. From a study of the statistics of influenza in several tuberculosis sanatoria, the conclusion is reached that in people with a mild or arrested tuberculosis a higher incidence of influenza is evident than in those of advanced type; in people with active tuberculosis a certain degree of immunity is produced by the constant presence of a low grade chronic inflammatory process of the respiratory tract, which protects them to some extent against a frank invasion of influenza. Cases of glandular tuberculosis, especially the cervical and tracheo-bronchial type of children, show a very high incidence of influenza, but very few frank cases of pulmonary tuberculosis follow. Individuals in the prime of life, apparently free from physical defects and previous history of illness are more susceptible to influenza.—*Postinfluenzal Tuberculosis, T. J. Murphy, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 267.*

Tuberculosis of the Skull.—Recent publications show that perforating tuberculous lesions of the skull are not so rare as generally assumed; 13 cases have been published by five French writers since Pelletier's compilation of 206 cases in 1910. About 75 per cent of the cases develop before the age of 20, and there are almost invariably other tuberculous lesions elsewhere. The lesion causes few symptoms, merely a dull ache roused by pressure and not worse at night. In the case illustrated, the opening in the frontal bone was a necropsy surprise. If the condition otherwise permits, extensive resection into sound tissue is the most certain means to ward off recurrence.—*La tuberculose perforante de la voûte crânienne, H. Roger, Presse Méd., August 28, 1919, xxvii, No. 48, 481.*

Tuberculosis of the Jaw.—A boy of eight developed a tuberculous process in one ankle, a year later one in the forearm, and later one in the tibia. Five years after the first symptoms, an abscess appeared in the left lower jaw and pus kept

reforming after repeated punctures. The entire left jaw shows notable thickening on radioscopy, with a zone of less opaque bone in the horizontal ramus. The prognosis of such lesions is grave. In Perrot's compilation of twenty-four cases, only ten of the patients recovered, and this recovery is precarious. In two cases the patients succumbed to tuberculous meningitis. The outlook in the present case seems absolutely bad.—*La tuberculose du maxillaire inférieur, A. Aimes and Aubanel, Progr. Méd., July 26, 1919, No. 30*, 293.

Tuberculosis of Conjunctiva.—One case in a boy of thirteen is reported. At the first examination (September, 1918), the conjunctival trouble had been present all summer. There was a large tumor mass high up under the lid of the right eye; two small reddish elevations on the bulbar conjunctiva near the caruncle extending toward the limbus, a third in the lower cul de sac; enlargement of the parotid gland, of another gland located just below and over the malar process; enlarged tonsils and adenoids. While the patient was under the anesthetic for the tonsil and adenoid operation, the lid was everted, and large masses of granulation tissue found, a majority of the granules being surrounded by a small yellow spot suggestive of tubercle. Slightly to the nasal side of the center there was a deep ulcer; when the exposed surface was scrubbed with gauze, there remained tough ridges of a lineal ulcer extending horizontally over the entire lid. The edges were trimmed with scissors and cauterized with nitrate of silver. Smears taken showed the presence of tubercle bacilli. The best local treatment was found to be cauterization with trichloracetic acid done once a week. From November, 1918, to February 15, 1919, tuberculin O. T. was given beginning with a dose of 0.0001 mgm. once a week, increased later to 0.0002 mgm. The patient was taken from school for three weeks, kept out of doors and not allowed to become fatigued. This regimen with the local treatment caused much improvement. The invasion of the lower lid disappeared, the upper lid is pale from scar tissue, but smooth, the eye free from irritation and conjunctival discharge.—*Tubercle of the Conjunctiva, J. A. Patterson, Am. J. Ophth., September, 1919, ser. 3, ii, No. 9, 679.*

Tuberculosis of the Retina. Not many cases of tuberculosis of the retina will be seen by any one observer. The authors report three new cases, and comment on two others from their earlier reports. The first case was observed for two and a half years, coming under observation in the early stages of retinal lesions on account of photophobia due to corneal involvement. The disease in the right eye progressed through the various stages, but in the left eye was controlled and apparently cured with the use of small doses of tuberculin. In case 2 only the left eye was affected, and this was cured and continued normal. In case 3 both eyes were affected and neither cleared up entirely. Of the two earlier cases, one remained in good health with no change in the retinal condition reported in 1914; the other had repeated vitreous hemorrhages and failing vision. From a study of these cases the authors conclude that retinal tuberculosis begins by the appearance of white infiltrates in front of certain retinal vessels, most frequently the veins; later these vessels show all the signs of perivasculitis, and the veins are altered in caliber. At this stage hemorrhages occur; these may be comparatively small and confined to the retina, clearing up at the end with good restoration of vision; or they may be extensive, pushing off or bursting into the vitreous and causing retinitis proliferans with great impairment of vision. In many cases in which the eyegrounds are visible throughout, white dots are formed in the macula, causing impairment of vision, but later clearing up entirely. Often both eyes are affected at first, but one may be only slightly involved and recover completely, while the other is permanently damaged. The course of retinal tuberculosis is protracted. All cases need the general regimen and treatment for tuberculosis; those without extensive tuberculous lesions elsewhere and without pyrexia, do well on small doses of tuberculin at intervals of at least a week.—*Tuberculosis of the Retina, E. Jackson & W. C. Finnoff, Am. J. Ophth., October, 1919, 2, No. 10, 715.*

Prognosis with Complicating Laryngeal Tuberculosis.—Every case of actual or suspected pulmonary tuberculosis should be examined by a skilled laryngologist, not only once, but repeatedly, for the presence or absence of laryngeal lesions has an important bearing on the prognosis. The author has examined the larynx in 1750 patients admitted to the Midhurst Sanatorium but tabulates the results for only 883 cases examined in the years 1911 to 1915, for whom complete after-histories are available. The cases are classified in three groups, as follows: group I, the disease limited to a small area of one or both apices; group II, cases more extensive but affecting at most the whole of one lobe or severe disease affecting one-half of one lobe; group III, all cases of greater severity than group II, including

those with considerable cavities. In the non-laryngeal cases, the percentage of deaths is lowest in group I, more than doubled in group II, and 70 per cent in group III. The total mortality for all three groups is 39.7 in seven years. In the laryngeal cases the mortality rate for group I rises from 15.6 to 42.9 per cent; for group II from 38 to 63.3 per cent; while the increase in group III is not so striking,—from 70.4 to 78.3 per cent. Taking all three groups together the presence of tuberculosis of the larynx raises the percentage of deaths in the 3 to 7 year period from 39.7 to 68.9 per cent. The tables indicate that of all fairly early cases of pulmonary tuberculosis admitted to a sanatorium, the expectation is that 60 per cent will be alive at the end of that period; but with similar patients with the larynx diseased, only 30 per cent will be alive. If the pulmonary condition of a patient warrants his being classified in group I, the discovery of a laryngeal lesion would grade him down to group II; while if the pulmonary condition would place him in group II, the involvement of the larynx lowers the prognosis to nearly that of group III.—*Prognostic Importance of Tuberculosis of the Larynx, St. C. Thomson, Lancet, October 18, 1919, No. 5016, 689*

Pneumohydrothorax.—Ninety per cent of all cases of this condition are due to advanced pulmonary tuberculosis. Two cases are reported and the conclusion is reached that pneumohydrothorax is rarer than formerly; that the prognosis is exceedingly bad; that like the complications of other diseases it is not recognized because not borne in mind and hence not looked for; and, finally, that little or nothing can be done for its correction or alleviation at present.—*Pneumohydrothorax, J. I. Johnston, Am. J. M. Sc., July 1919, clxviii, No. 1, 105.*

Mitral Stenosis and Pulmonary Tuberculosis.—Montenegro corrects his statement made in several of his previous articles to the effect that tuberculosis and mitral stenosis could not coexist. He states that it does occur, but very rarely, and reports that out of 20,000 cases of pulmonary tuberculosis one was found with mitral stenosis (a proportion of 0.005 per cent) and that out of 300 cases of mitral stenosis one was found with pulmonary tuberculosis (0.3 per cent). Mitral stenosis inhibits, retards or attenuates the progress of pulmonary tuberculosis.—*Estreches Mitral y Tuberculosis Pulmonar, J. V. Montenegro, Arch. Espan. d. Tisiologia, January 1919, i, No.* 1, 89.

Pulmonary Tuberculosis and Irritable Heart.—There is a superficial resemblance between the symptoms of "irritable heart of soldiers" and those of active pulmonary tuberculosis. Ready fatigue, breathlessness, tendency to excessive sweating, tachycardia, and symptoms of asthenia are common to the two conditions. Pain in the left chest, however, which is one of the commonest symptoms of irritable heart, is not characteristic of pulmonary tuberculosis. In the careful study of the history of men with irritable heart, a background of neurotic symptoms, neurologic disease, mental inferiority, emotional instability or psychic maladjustments is almost invariably discovered. Such conditions are, of course, not characteristic of pulmonary tuberculosis. The General Hospital No. 9, Lakewood, N. J., has made the following observations: (1) In a group of 246 men with "irritable heart of soldiers" studied at this hospital, one was found with definite signs of arrested pulmonary tuberculosis. Two men of this group developed active pulmonary tuberculosis after influenza. No other diagnosis of pulmonary tuberculosis was made. (2) Intensive study of 32 cases of irritable heart showed arrested pulmonary tuberculosis in only one case, with no instance of active tuberculosis. No evidence has been found, from the study of irritable heart at this hospital, that there exists more than an accidental relationship between this condition and pulmonary tuberculosis.—*A Study of the Incidence of Pulmonary Tuberculosis in Soldiers with Irritable Heart, J. T. King, Jr., Arch. Int. Med., August 15, 1919, xxiv, No. 2, 238.*

Physical Basis of Gastrointestinal Symptoms in Pulmonary Tuberculosis.—The embryological origin of the respiratory system from a diverticulum of the gastrointestinal canal, gives to the lung the same double innervation as that of the intestinal tract. All smooth musculature and all secreting glands of the lungs and bronchi, like those of the stomach and intestines (except the sphincters) are activated by the vagus nerve and inhibited by the sympathetic. When the lung is inflamed, the sensory fibres of the pulmonary branches of the vagus are irritated, and this produces a reflex stimulation of the motor neurons of the vagus which supply the gastrointestinal canal. The common gastrointestinal symptoms typical of preponderating vagus stimulation are nausea, vomiting, hyperchlorhydria, gastric supermotility, colicky pains, spastic conditions of the intestines, notably

spastic constipation, colitis, diarrhea, and intestinal stasis. And it is this group of functional disturbances that is found most frequently in patients suffering from early active or chronic semi-quiescent tuberculosis. During the stage of toxemia the cells of the entire nervous system are irritated by the toxins, which act primarily upon the sympathetic nerves and in this manner cause a general inhibition of action through the gastrointestinal tract, submotility, hypochlorhydria, and constipation due to lessened secretion and lessened peristaltic action. In studying the gastrointestinal symptoms in pulmonary tuberculosis, it is necessary to distinguish between the active form of the disease with marked toxemia and the type in which toxemia is not prominent. It is also necessary to know the nervous, physical and psychical condition of the patient before the pulmonary tuberculosis developed, and to know whether he previously suffered from any particular type of digestive disturbance. For the patient's nervous condition will determine to a great extent whether the reflex stimulation is sufficient to overcome the action of opposing nerves and produce the characteristic symptoms. Other factors also have a part in the causation of the gastrointestinal symptoms in pulmonary tuberculosis, but a thorough knowledge of the visceral nerves and their relationships will place these symptoms on an understandable basis.—*Physiologic Basis of the Common Gastrointestinal Syndromes in Pulmonary Tuberculosis, F. M. Pottenger, Boston M. & S. J., October 23, 1919, clxxxi, No. 17, 501.*

Intestinal Occlusion in Tuberculous Peritonitis.—Intestinal occlusion rarely occurs during tuberculous peritonitis, regardless of the varied and numerous lesions created by the process. Occlusion is twice as frequent in the female in both the acute and chronic types of this disease and is encountered at any age. Acute occlusion is most frequently the result of intestinal paralysis, a band, an intestinal kink, and much more rarely invagination, volvulus or torsion of the mesentery. Chronic occlusion is produced by agglutination of the intestinal coils, multiple bands, or fibrocaseous masses. The ascitic form of tuberculous peritonitis does not give rise to occlusion. The acute miliary form provokes occlusion by the mechanism of intestinal paralysis. Other causes of occlusion result from chronic peritonitis. Paralysis may intervene in occlusions produced by a real obstacle and superimpose its action to that of a band or kink. Generally speaking, the lesions are much more extensive in chronic occlusion than in the acute forms.

An occlusion may arise during a tuberculous peritonitis which has been recognized, but it is often encountered as an initial accident of a latent tuberculosis of the peritoneum. In these circumstances the diagnosis of the tuberculous nature of the lesions which provoke the occlusion is difficult, if not impossible, to make. Given an acute occlusion, one should always think of tuberculosis and look for tuberculous localizations which may indicate the way to the diagnosis. It is to be remembered that an acute occlusion from tuberculous peritonitis may closely simulate appendicitis or acute peritonitis. The fecal vomiting is not constant and not necessary for diagnostic purposes. Complete stercoral arrest, and a thermic drop are sufficient evidences of occlusion.

When diagnosis is doubtful, abdominal incision should be resorted to if only to discover the nature of the morbid process and site of the lesions, while at the same time it is the best form of treatment. Medical treatment may be essayed in acute occlusion, and if too much time is not wasted in the use of electric enemata these should be tried, at least at the onset of the symptoms and especially in circumstances where an immediate operation is an impossibility. Abdominal incision is the treatment of choice in acute occlusion and the one which offers the greatest benefits to the patient, but it must be carried out as rapidly as is consistent with good surgery. Exploratory laparotomy has given unquestionably good results when the occlusion has been due to paralysis of the gut. Enterotomy should be employed preferably in circumstances where a proper technic cannot be carried out or where the patient's condition demands rapid work. In chronic occlusion, where the lesions are usually extensive, operation is not to be rejected for this reason, because after exploring the abdominal cavity an artificial anus or an enteroanastomosis can be done according to the demands of the case. A considerable retrogression of the lesions and pseudotumors—occasionally their complete disappearance—is frequently observed after abdominal incision.

The prognosis of intestinal occlusion in tuberculous peritonitis is serious and the operative mortality is greater in the acute than in the chronic forms, being 24 per cent in the former and 18 per cent in the latter. The mortality from generalization of the tuberculosis is 14 per cent in acute occlusion and 32 per cent in the chronic forms. Recovery is 61 per cent in the acute types, as against 50 per cent in chronic occlusion.—*Editorial Note, N. York M. J., December 13, 1919, cx, No. 24, 1993.*

Difficulties in Diagnosis and Treatment of Unilateral Renal Tuberculosis.—In the great majority of cases of tuberculosis of the genito-urinary system in the male, the primary focus is found either in the kidney or in the globus major of the epididymis; from these foci the infection spreads to the excretory ducts of the organs primarily involved, and to structures lying on the course of and in connection with these ducts. The major symptomatology of urogenital tuberculosis depends upon these extension processes rather than on the existence of the primary foci. In the great majority of cases in males the disease is not diagnosed while limited to the kidney, but the first cystoscopic examination shows an involvement of the bladder wall nearest the ureteral orifice. If there is a more extensive involvement of the bladder, the prognosis is grave. Surgeons agree that unilateral renal tuberculosis should be treated by nephrectomy, but the disposal of the diseased ureter is not governed by any such general rule. Indications for the total removal of the ureter are: (1) ureter strictured below, dilated above and secondarily infected; (2) ureter dilated, infected and in free communication with the bladder; (3) ureter enlarged, soft and diffusely involved in a subacute miliary tuberculous process. In other cases the ureter should not be disturbed, or only such part removed as can be reached through the ordinary nephrectomy wound. Unilateral renal tuberculosis may be overlooked in the presence of a complicating genital infection or in the presence of a more obvious nontuberculous lesion in the opposite kidney. Two illustrative cases are reported. Primary tuberculosis of the bladder is undoubtedly possible, but is a very rare condition. In some cases a primary renal lesion is so limited, and gives rise to so few symptoms, that the more obvious bladder tuberculosis appears to be primary. A case is reported in which the indigo-carmine test showed faulty function of the left kidney, but no tuberculous focus was found by an exploratory incision.—*Unilateral Renal Tuberculosis, L. Herman, Ann. Surg., August, 1919, lxx, No. 2, 203.*

Ascending Renal Tuberculosis.—That ascending renal tuberculosis, though not common, can occur is proved by two cases which came to operation. It cannot be ascertained that the secondary involvement of the kidney occurred in the true ascending fashion, by continuity of surface, for it might well have taken place through embolic processes. It is notable that nephrectomy benefited both of these patients in spite of the fact that the kidney lesions were minimal compared to the changes in the bladder and lower ureter. This is explained by the fact that removal of the organ put an end to the more or less constant reflux and stagnation of tubercle-laden urine in the lower ureter, giving the bladder a chance to take care of itself. The distinction between ascending renal tuberculosis and the usual descending form cannot be made out by clinical methods it seems, for in both cases bacilli are found in the urine coming from the pelvis of the kidney. On examining the removed kidney, however, one finds the tuberculous changes to be almost insignificant as compared to those found on cystoscopy of the bladder; the parenchyma may be free from disease or contain only a few miliary tubercles on section. The surface of the organ also appears healthy. The lesions are practically confined to the pelvis and calyces, increasing in extent as we examine the ureter nearer and nearer the vesical orifice. *Concerning Ascending Renal Tuberculosis, L. Buerger, Am. J. M. Sc., October, 1919, clviii, No. 4,* 482.

Rapidly Fatal Spinal Caries.—Three cases of spinal caries are reported in soldiers of the British Expeditionary Forces. All of the men appeared robust and in excellent health except that case 3 had suffered with pains in the back for several years. The chief symptoms were pains in the back, paralysis of the legs, loss of sensation especially in the legs, but extending upwards as the disease progressed. The illness lasted six days in case 1, fifteen days in case 2, and nine days in case 3. The onset in each case was sudden and without warning. In case 2 some impairment of resonance was found over the base of the left lung, and small crepitations over both lower lobes. Autopsy showed a tuberculous cavity and a few small superficial caseous nodules in the left lung and adhesions on both sides. A large tuberculous gland was found in the mesentery. In the other two cases no pulmonary signs were found during life. Autopsy in case 1 showed both lungs bound down at the base to the diaphragm by old adhesions; more recent adhesions of the left lung to the pericardium and to the chest wall; miliary tubercles in both lungs. In case 3 a diffuse miliary tuberculosis was found in the lower lobe of the left lung, and old calcareous foci in the upper lobes of both lungs.—*Rapidly Fatal Spinal Caries, J. R. Collins, Brit. M. J., August 30, 1919, No. 3061, 265.*

Tuberculomata of the Spinal Cord.—The tubercle, the most frequent variety of intramedullary tumors, is most commonly

met with in males from twenty to forty years of age. The morbid process is more prone to occur in the dorsolumbar segment of the cord, preferably in the gray matter. Contrary to the classical descriptions which give a clinical picture of tubercles of the cord in general, it is necessary to divide these lesions into three distinct types, the first of which is tuberculoma of the dorsal region, which at the outset produces a typical Brown-Séquard syndrome in some cases and ends in a spasmodic paraplegia with a more or less complete anesthesia. Secondly, the tuberculoma of the lumbar cord, beginning with painful and atrophic phenomena in one leg, thus simulating a serious form of sciatica and ending in a limp, atrophic paraplegia with anesthesia and paralysis of the sphincters. Thirdly, tuberculoma of the cervical expansion, the début of which is also manifested by painful and atrophic phenomena, but these are limited to the arms, while the tuberculoma, continuing its evolution, gives rise to a homolateral spinal hemiplegia, with or without Brown-Séquard's syndrome and ending in a complete spasmodic paraplegia with anesthesia reaching to the upper part of the trunk. In some cases bulbar phenomena appear. During the evolution of a tuberculoma of the cord the disturbances of sensation offer a radicular topography, whether or not they extend to one-half or the entire body. They have a certain predilection for thermic sensibility. They may also assume sensibility to pain of the syringomyelic type, which can be explained by the localization of the tubercle in the gray matter between the anterior and posterior horns. Although in intramedullary tumors radicular phenomena have been regarded as rare, it would appear that tuberculoma offers an exception in this respect, because certain forms, particularly those of the enlargements of the cord, have a distinctly radicular phase—pain and atrophy. In one case the explanation of the importance of these radicular symptoms was given inasmuch as there was a true infiltration with degeneration of the anterior and posterior roots (Ackerman, *Thèse de Paris*, 1914). Ackerman has, like most other writers, noted the great frequency of unilateral development of the tubercle. Even when it reaches very considerable size one-half of the cord will be found to be pushed aside, but it is normal. This is in accord with the clinical evolution, because the symptoms are unilateral and also on account of the possibility of a predominance of disturbances on one side until the end of the affection. Although meningeal lesions are common they are, in these cases, usually secondary to the process in the cord. In one case they consisted of a true pachymeningitis, while in another instance of tuberculoma of the cord there was a tuberculous lesion of the spine, although there was no immediate relationship between the two processes, the bone lesion being seated in the first lumbar vertebra, the tuberculoma occupying the fourth and fifth dorsal segments. In all cases of tuberculoma of the cord pulmonary or suprarenal tuberculous lesions are present. The tuberculoma offers different histological aspects according to the case. It may be in the form of an agglomeration of follicles or as a compact caseous mass. Giant cells may be found, but Koch's bacillus is apt to be absent in the sections.—*Editorial, Med. Rec., November 1, 1919, xcvi, No. 18, 729.*

Nervous Irritability and Tuberculosis. —Attention is called by Ferranini (The Nervous System in the Tuberculous: *Riforma Medica*, February 22, 1919) to the extreme and intense excitability of the nervous system in tuberculous patients. He reports various laboratory measurements which reveal the rapidity and early exhaustion of nervous reaction with the weakened tonic capacity which accompanies it. He attributes this to the action of the toxins upon the nerves, which, with the action upon the endocrine system or the effect of the latter action again upon the nervous excitability, forms a vicious circle. To this must also be added toxic irregularities of growth which affect principally the nervous system, which may be of importance in the growth of the young. Such manifestation of this nervous excitability may be of diagnostic import in the case of older individuals.

From this important viewpoint there is seen to be a possible close association of tuberculosis with the nervous system in its anatomical growth. For the author also describes the injury that may result to the spinal cord and its roots by an exaggerated growth of the brain, through the physiological disturbance which results, or through the toxic action upon the nerves or through the endocrine system. And all this serves to open the way to a still further very important consideration of which the anatomical and physiological facts are a basis. If one considers these as the pathways of energy distribution and as such informed and governed by the putting forth of energy or the withholding of it from output which marks the personality, there appears another most important and nonnegligible point of attack upon this nervous phase of tuberculosis. The extreme irritability is indeed a most important diagnostic sign. It may be also psychically a diagnostic and therapeutic factor of which service should be

made. The most advanced psychic therapy aims at the discovery of energy exhaustion in a badly regulated output or in a restraint of external output for hidden psychic reasons, which interferes with active utilization upon the external world and its interests. In such case the energy is driven to an activity within the physiological or autonomic personality, there to produce serious disturbance, which causes receptivity rather than resistance to infectious agents and their activity. Does not therefore the calling of attention to this significant nervous irritability strongly suggest the necessity of psychotherapeutic inquiry? The initial and warning appearance of such proof of badly used energy should contain significant possibilities, at least in incipient cases of tuberculosis. There should be a promising field here for prophylaxis against the development of such a psychic state and its consequent influence upon the physiological condition. An instance like the following is all too typical of the complete lack of understanding on the part of the patient and of the medical measures which too often foster the destructive energy activity in its secret psychic and physiological strongholds. No means are used to discover it and direct it to a discharge which would relieve the overwrought nerves and other physiological pathways. A patient with a comparatively mild infection, but with a disposition which had timidly, but unconsciously to itself, shrunk from all forms of effort demanding responsibility, most conscientiously took the doctor's advice and undertook to combat the disease by the most rigid abstention from all interests at home or abroad which could demand the slightest effort, kept the letter of the law most scrupulously, but rapidly declined and died. The actual ravages of tuberculosis were insufficient to have caused her death but the entire nervous system had reached a hypersensitivity which had produced an uncontrollable nervousness and a general derangement of all the organs so that the anarchy within the body was such that life could no longer be maintained. All the efforts of the physicians, as well as of the patient, had been toward fostering energy, but all avenues for its safe discharge had been neglected or deliberately cut off. Should not the testimony from the anatomy and physiology of the nervous system drive medicine also to a consideration of the psychotherapeutic duty involved in such cases?—*Editorial, N. York M. J., September 6, 1919, cx, No. 10, 423.*

Symptoms and Diagnosis of Primary Tuberculosis of the Uterus.—It is certain that disturbances arising in the genital system of the female may have a particular significance when they occur in subjects having tuberculosis, but in the case of primary tuberculosis of the uterus where the anamnesis offers nothing to arouse suspicion, the difficulty of appreciating their value can be easily conceived. Not many years ago menstrual disturbances were given such importance in this respect that they were regarded as pathognomonic of bacillosis. There may be amenorrhea occasionally, but more frequently unimportant variations in the regularity of the menses are observed. Likewise, the amount or quality of the uterine secretion does not constitute a reliable sign of tuberculosis of the organ, but when after a free flow an elimination of caseous material takes place, the probability of tuberculous lesions should be immediately thought of. Search for the bacillus will often confirm the diagnosis. It has been maintained by some that primary dysmenorrhea—occurring with the first appearance of the menses in contrast with secondary dysmenorrhea, which is almost always the result of some affection of the organs of generation—is frequently the initial symptom of a tuberculous focus in the genital apparatus and consequently is of paramount importance in the diagnosis of tuberculosis of the uterus.

One encounters young girls or young women with metrorrhagias which cannot be explained either by chlorosis or lymphatism. Medical treatment is without avail, while light curettement often has no beneficial result, so that at length the uterine cavity has to be painted with tincture of iodine or a solution of perchloride of iron or chloride of zinc. In a certain number of these patients pulmonary tuberculosis develops later, and for this reason Vincent, of Lyons, had the fungous scrapings removed from the uterus examined bacteriologically. The result was that the fungosities contained characteristic tuberculous elements. The clinical data were consequently confirmed by pathology as to the tuberculous nature of the causative factor of the obstinate metrorrhagias. From his findings Vincent does not pretend that every socalled essential metrorrhagia or menorrhagia is tuberculous, and the cases he has observed are exceptional, as he himself points out, but the conclusion to be drawn is that the clinician is thus warned of the possible danger of tuberculosis. In a large number of cases the genital lesions may remain dormant for many months, but the tuberculosis may become generalized during this time, making the prognosis serious. Sometimes the generalization occurs suddenly, giving rise to a miliary process; at others, the secondary lesions assume the classic chronic types, and finally, in other in-

stances, the tubercle bacillus extends by continuity to the tubes and peritoneum, there setting up inflammatory reactions which later on may serve as the starting point of a general infection.—*Editorial, N. York M. J., December 6, 1919, cx, No. 23, 947.*

Tuberculosis of the Uterus. The disease occurs at all ages but is most common between twenty and twenty-nine years, and in the following decade. It occurs in four main types: ulcerative, miliary, interstitial and peritoneal. In the earliest ulcerative type the lesion is microscopic and consists of minute yellowish-white nodules upon the mucosa, which increase in size, coalesce, caseate and finally ulcerate, throwing off necrotic material into the uterine cavity. The least frequent form is the interstitial, which attacks the connective tissue among the muscular elements and finally destroys the muscle bundles. While usually tuberculosis of the uterus is secondary there are well authenticated cases on record of primary involvement where the infection took place through coitus or the use of infected instruments. The symptoms of the condition are not at all typical and are those of any other inflammation of the uterus. They usually consist of menstrual disorders such as menorrhagia, dysmenorrhea, and at times amenorrhea. The most frequent, however, is metrorrhagia accompanied by a feeling of weight in the pelvis which becomes worse at the time of the menstrual period. Definite pain is rather of late appearance, while leucorrhea is not infrequent. The cervix uteri may offer no findings suggestive of the condition, and in those rare cases where it is involved it has the appearance of carcinoma. The uterus may feel boggy and softer than normal, and, at times much enlarged. Although in most of the cases the tubes will be found involved, absence of enlargement of the Fallopian tubes does not exclude tuberculosis of the uterus. The presence of a family history of tuberculosis, particularly of a husband suffering from tuberculous involvement of penis, testicles or epidydimis, is of great value in diagnosis. While sterility is common in this condition pregnancy has been known to take place not infrequently. The most positive method of diagnosis is the examination of the leucorrheal discharge, but the staining method is not always sufficient on account of the frequent presence of other acid-fast bacilli in the discharge. Examination of the curettings or better, grinding them up and making of an emulsion for the inoculation of a guinea pig are the best methods. The prognosis is nearly always gloomy, except where it is possible by an operation to remove the diseased organs fairly completely. There is even a fair degree of success in cases where the uterus alone is involved in mere curettage and cauterization. Drainage should not be employed after operation for the cure of this condition as it predisposes to mixed infection.—*Tuberculosis of the Uterus, J. R. Scott, Calif. State J. M., February, 1919.*

Tuberculosis of the Anus.—Primary tuberculosis of the anus or rectum is rare, but secondary lesions in patients with phthisis are quite frequently seen. Anal tuberculosis may be either miliary, ulcerative, lupoid or verrucous. The miliary type is very rare. Tuberculous ulcers at the anus begin insidiously, often following a slight injury. The borders of the ulcers are clear cut with a ring of induration; the base is irregular, gray in color and does not bleed easily; on the surface are small yellow tubercles. There is not much pain with the passage of feces, or on manipulation for examination. The ulcers spread continuously in all directions, slowly in some cases, and rapidly in others. Lupus ulcers are usually multiple with soft insensitive bases and edges covered with granulations; the discharge is profuse but odorless. The first evidence of the presence of the tubercle bacilli is the development of translucent gray nodules; these nodules coalesce and may undergo necrosis, or an abscess may result, probably owing to secondary infection. If healing fails, an ulcer results, its base covered with yellow necrotic material, with tuberculous granulation underneath. Infection of the bowels and the anus in patients with phthisis is caused by swallowing the infected sputum. This should be prevented as much as possible. When infection and ulceration have occurred, medication by mouth is not beneficial. If the patient's condition is fairly good, the anal ulcer may be thoroughly curetted with the Paquelin cautery, and exposed to the sunlight and air for several hours each day, with a light covering of white cloth to prevent painful sunburn. When the patient is too weak for cauterization, exposure to sunlight alone often gives excellent results. For anal lupus, either the Finsen light or the roentgen ray may be used. The use of both is pushed till a blister or burn results, and treatment is repeated when this reaction has subsided.—*Tuberculosis of the Anus, C. J. Drueck, Surg., Gynec. & Obstet., October, 1919, xxix, No. 4, 393.*

Pulmonary Abscess, Bronchiectasis and Tuberculous Cavity. In the differential diagnosis of pulmonary abscess, bron-

chiectasis and tuberculous cavity the history will be of greater aid than the physical examination. Pulmonary abscess usually follows acute infection of the lung with any of the pyogenic organisms and is also common after operations on teeth, tonsils and nasal cavities as a result of inhalation. In abscess there is a history of acute onset, periodical rises in temperature, and sometimes bloody, sometimes foul-smelling, expectoration. Clubbing of the fingers comes on earlier and becomes more marked in this condition than in any of the others. Abscess is commonly located in the lower lobes. Bronchiectasis usually follows a pneumonia in childhood, although it may follow this condition in adult life; it may also begin with a bronchitis. The cough is loose, indicating that the secretion is in the larger bronchi where it is easily moved. This is of diagnostic value. Clubbing of the fingers appears slowly and is never as marked as in abscess. Tuberculous cavity formation is more liable to be preceded by repeated attacks of toxemia, sometimes months apart. There is more nervous irritability, more nutritional disturbance and wasting with increased reflexes of the chest muscles. Repeated attacks of bronchitis are common in both tuberculosis and bronchiectasis but not in pulmonary abscess. Tuberculous cavity is most common near the apex, bronchiectatic cavities near the hilum. The scarcity or total absence of râles is characteristic of both bronchiectasis and abscess, while in cavitation they are found in large numbers around the cavity, unless the latter is surrounded by scar tissue.—*Points of Differential Diagnostic Value in Pulmonary Abscess, Bronchiectasis and Pulmonary Tuberculosis, with an Explanation of the Cause of the Difference in Auscultatory Findings, F. M. Pottenger, Am. J. M. Sc., October, 1919, clviii, No. 4, 502.*

Diagnosis of Bronchiectasis.—While bronchiectasis will rarely be confused with acute progressive phthisis, it may be difficult of differentiation from that form of tuberculosis characterized by mild constitutional symptoms, little or no wasting, with physical signs suggestive of marked fibrosis. Especially will it be difficult to recognize those cases of bronchiectasis showing an elevation of temperature during the afternoon hours, and hemoptysis. These latter symptoms, however, are by no means pathognomonic of tuberculosis as formerly believed and are common occurrences in bronchiectasis. The history is most important and will reveal in cases of bronchiectasis that there are not and have not been present those symptoms of toxemia characteristic of tuberculosis; and the patient is in fair health in spite of the profuse expectoration and distressing cough. Physical examination shows a unilateral lesion, most frequently involving one of the lower lobes. The differential diagnosis may be more difficult in cases where there is a complicating pleural effusion. The latter need not be considered as pathognomonic of tuberculosis any more than the symptoms mentioned above, since pleural effusion may occur in other conditions, such as carcinoma of the lung, as well as in bronchiectasis. The same criteria will aid the diagnosis in these cases; absence of wasting, unilateral character of the lesion and absence of bacilli in the sputum on repeated examinations. Rarely bronchiectasis is found in one of the upper lobes; in such cases prolonged observation will be necessary. Bronchiectasis is due to a combination of causes within and causes external to the bronchi. Among the former, pertussis, acute and chronic bronchitis, and foreign bodies are best known. An inflammatory process in the wall of the bronchi due to local infection tends to paralyze the underlying muscle tissue. Chronic interstitial pneumonia and thickened pleura of nontuberculous origin are the extra-bronchial causes.—*Bronchiectasis: Its Differentiation from Pulmonary Tuberculosis, B. Stivelman, Am. J. M. Sc., October, 1919, clviii, No. 4, 516.*

Roundworms and Lung Disease.—It has long been known that the roundworms of man (*Ascaris lumbricoides*) sometimes occur elsewhere in the body than in the small intestine, their usual habitat. Until the recent investigations of Stewart, however, the fact that the *Ascaris* is regularly parasitic in the lungs during an early stage of its development was not even suspected. Stewart's experiments have been repeated and the facts verified by Yoshida and by Foster and Ransom, and the important discovery made, that the larvae of *Ascaris* after hatching in the intestine of an animal that swallows the eggs migrate to the lungs and then return to the intestine, has been fully confirmed. Foster and Ransom, however, do not reach the same conclusions as Stewart as regards the rats and mice being intermediate hosts. No such intermediate host is necessary. The important points deduced are as follows: Infection occurs as the result of swallowing eggs of the parasite containing fully developed embryos, no intermediate host being necessary. After the young worms hatch in the intestine they do not immediately settle down, but migrate to the liver, lungs and other organs meanwhile undergoing considerable growth and development. Those

that reach the lungs return to the intestines by way of the trachea and esophagus, then settle down and develop to maturity if the host is suitable; otherwise they are soon eliminated in the feces or they may not fully mature in some hosts. Pneumonia commonly occurred in experimentally infected animals about a week or ten days after infection, at a time when the invasion of the lungs by the migrating larvae is at its height. Ransom quotes a rather indefensible experiment by Mosler in 1867 and some observations by Lutz as to the pulmonary symptoms being caused in human individuals by the ingestion of *Ascaris* eggs. With our present knowledge it would seem a matter for careful investigation especially in the case of pulmonary diseases of young children.—*A Newly Recognized Cause of Pulmonary Disease—Ascaris Lumbricoides, B. H. Ransom, J. Am. M. Ass., October 18, 1919, lxxiii, No. 16, 1210.*

A Scheme of Treatment of Tuberculosis.—One of the weakest links in the present schemes for handling the tuberculosis problem is the present method of reporting the disease. It conveys no information regarding the type of the disease, the extent to which there exists danger of infection, or the home conditions and circumstances of the patient, and it places no initial responsibility on the medical practitioner with regard to these important points. The first essential unit in the scheme is the dispensary, which must be connected in an intimate relationship with the medical practitioner, the hospital and the sanatorium. Its function is to serve as a center for diagnosis, treatment, observation and dissemination of knowledge with regard to preventive treatment. The success of the dispensary depends in large measure on the extent to which adequate provision is made for the immediate admission of patients to hospitals and sanatoria. The hospital for the treatment and segregation of acute and active cases is in many respects the most important unit of the antituberculosis scheme. Its success depends upon adequate and suitable accommodation, compulsory powers of removal where necessary, its central position, a high and sustained standard of treatment and nursing, and the immediate interchange of patients between the hospital and sanatorium when such is indicated. The third unit, the sanatorium, should possess facilities for the industrial training of patients. The patient is kept in the sanatorium as long as there is any possibility for further improvement, and as long as there is no prospect of immediate return to satisfactory home conditions and to some form of employment suitable to his capacity for work. The following conditions must be fulfilled in order that the sanatorium may yield permanently satisfactory results: A high and uniform standard of treatment, the selection of early and arrestable types of cases, early admission, adequate accommodation, prolonged treatment with training in suitable occupations, an official scheme of after-care, healthy home conditions and an adequate and efficient standard of the allied units of treatment. The absence of adequate and suitable provision for the conservative treatment of surgical or non-pulmonary tuberculosis constitutes one of the weakest links in the present methods of treatment. The results obtained by modern conservative treatment of these cases are excellent both with regard to recovery and the prevention of deformity, and well repay the cost incurred. The successful treatment of these cases requires that large special hospitals be provided in suitable localities. The present system of domiciliary treatment has to be reconstructed. It requires an efficient medical and nursing service and satisfactory home conditions. The cleavage advocated between preventive and curative treatment is neither practicable nor desirable. Open-air schools while indispensable in any scheme, must be supplemented by proper home conditions, sanitary surroundings, pure milk and proper food.—*A Scheme of Treatment of Tuberculosis, H. H. Thomson, J. State Med., October, 1919, xxvii, No. 10, 297.*

Newer Methods of Treatment.—Outdoor pure air, plenty of good food and rest are the secrets of cure in tuberculosis. Infants under two years should be especially protected from infection. The best means of preventing reinfection and the development of phthisis in older persons is to abolish poor hygienic living and industrial conditions that reduce the normal resisting power of the body. In treatment of active cases with fever, rapid pulse, anorexia and loss of weight, perfect rest in bed is indicated. As the symptoms subside graduated work or graduated walking exercises can be begun, the effects on pulse and temperature being carefully noted. The patient should be kept continually in pure air, and preferably out of doors and in the country. Home treatment is suitable for some cases where the proper surroundings can be provided and the patient saved from worry; in other cases a change of surroundings and sanatorium treatment are more beneficial. The climatic conditions are not so important as the nature of the surroundings and the routine of treatment. All climates can cure phthisis. Contrain-

dications for high climates are dyspnea, tachycardia, heart weakness and marked nervousness. Cardiac and renal cases can be sent to sea climates, consumptives with bronchitis and emphysema to desert climates. The diet must be individualized; over-feeding should be avoided; the food should be increased so that the patient gains in weight and maintains his normal weight. No special diet is indicated where digestion is normal; patients losing steadily in weight and strength need more and better food. Tuberculin is a help to other therapeutic measures and should be used in selected cases. It is best given in moderately advanced cases not improving under hygienic treatment; it is contraindicated in febrile cases. Small doses, carefully increased, are given to avoid producing reactions. There is no drug that will cure tuberculosis. Certain drugs are indicated for special symptoms; e.g., creosote, creosote carbonate or guiacol carbonate for the cough; atropin or agaricin for the night sweats; arsenic hypophosphites and glycerophosphites as tonics. Artificial pneumothorax is one of the recognized methods of treating pulmonary tuberculosis; the gas injected causes collapse of the diseased lung and puts it at rest. There are dangers in this treatment which may be avoided by careful technique, especially by the use of the manometer. The chief indications for artificial pneumothorax are: (1) acute and progressive phthisis, (2) recurring and severe hemorrhages in unilateral cases, even where the other lung is slightly affected. Contraindications are: (1) miliary tuberculosis, in which both lungs are usually affected; (2) diseases of the heart, blood vessels and kidneys; (3) pleural adhesions. About 5 per cent of cases are suitable. The treatment must be kept up for two to four years, sometimes longer. In properly selected cases, there is great improvement and sometimes cure. The most important point for successful treatment is the early diagnosis of incipient cases. In these cases the open-air and rest treatment may effect a cure. Moderately advanced cases usually have a chance, and many non-febrile cases can do useful work. Arrested cases can return to their former occupation unless it is especially unhealthful. They should live simply and avoid overstrain.—*Newer Methods of Treatment in Pulmonary Tuberculosis, M. Kahn, Long Island M. J., June 1919, xiii, No. 6, 165.*

Treatment of Early Tuberculosis.—In dealing with tuberculosis it is important to determine both the extent of the lesion and the personality and resisting power of the patient. Rest—the most important element in the treatment of tuberculosis—means not only physical rest, but also such mental treatment as will induce contentment and hopefulness. In certain instances early cases may be treated at home, where proper surroundings can be provided, and where the patient will be more contented at home than in a sanatarium. The essentials for home treatment are an airy room, preferably on the sunny side, rest in bed, cleanliness and intelligent attendance. In favor of sanatorium treatment are the discipline and training in self-care; there is danger, however, of morbid introspection, self consciousness and "hospitalism" being developed. If this tendency can be avoided, the institutional treatment is undoubtedly superior for the great majority of tuberculous cases. There are some who claim that certain climates, especially high altitudes, are necessary for the cure of tuberculosis, but the author believes that good results can be obtained in any climate, although sections where there is the least rainfall and the fewest variations in temperature are preferable, as giving the best opportunity for life out of doors. Diet is another essential in proper treatment. There is no "inherent virtue" in milk or eggs or cream, but the question is one of providing a nutritious and palatable diet containing more heat units than the patient absolutely requires, in order that the body may build up a reserve. The diet should be varied and suited to the patient's appetite. The gastrointestinal functions must be watched, and precautions taken to prevent digestive disturbances. In addition to rest, fresh air and proper food, there must be some diversion, and absolute cleanliness, especially in the care of the excreta. There is a considerable diversity of opinion as to the value of tuberculin in treatment, as well as in regard to the particular preparation to be used. Possibly the T. R. preparation is more generally employed. The author is of the opinion that tuberculin is of value chiefly in surgical tuberculosis and in those patients who are impressed with its use as a part of general treatment. Autogenous vaccines have been recommended in cases of mixed infection, but experience with their use is limited. The treatment of moderately advanced cases is practically the same as in early cases. More complications are likely to arise, such as bronchitis or laryngitis with persistent cough, hemoptysis and gastric complications. All these symptoms must be treated by appropriate measures as they arise.—*The Treatment of Early Tuberculosis, H. G. Webster, Long Island M. J., June 1919, xiii, No. 6, 182.*

Colony Treatment and After-Care.—The entire question of the after-care of the consumptive when discharged from the sanatorium and of the colony plan are still under discussion and there exists much difference of opinion even among those who are giving the question most careful attention. While a job in the country has been recommended by many for tuberculous patients, in actual practice the work and surroundings of ordinary farm life are entirely unsuitable for the consumptive. There is also great difficulty in training the consumptive for any suitable trade at which he could work under favorable conditions, and fit him to compete in the open labor market and earn sufficient wages to support himself and his family. If he attempts to return to his old job, under ordinary competitive conditions, this, too, in the majority of instances, ends in disaster. To meet these conditions, the colony plan has been developed to supply an industrial community where the consumptive may work in a suitable environment and where his mode of life may be carefully regulated. In the model colony, the provisions are such that the family may live with the patient. In considering types of employment suitable for consumptives, it is not necessary to limit them to industries carried on in the open air. Strenuous and prolonged physical labor must be avoided, and modern machinery employed. In a well ventilated workshop, with proper machinery and carefully regulated hours of work, the consumptive may earn a reasonable wage. It is not sufficient, however, to maintain a proper standard of living for himself and his family, for even under favorable circumstances, the consumptive cannot do the full work of a healthy man. Hence industries for consumptives must be to a certain extent subsidized by the State; and this the State can afford to do as a protection against the spread of infection. The Inter-Department Committee as a result of its inquiries, has recommended that the plan of the Papworth Colony should be adopted for development in various centers of the country.—*Further Experiences in Colony Treatment and After-Care, G. S. Woodhead and P. C. Varrier-Jones, Lancet, September 20, 1919, No. 5012, 526.*

Mortality after Sanatorium Treatment.—A report issued by the British Medical Research Committee on the after histories of patients from the King Edward Sanatorium shows that all but 3.5 per cent of the patients discharged from that sanatorium up to 1914 have been traced. The study presented in the report, however, is based on the records of seven years, covering 1053 men and 654 women. Comparison of the mortality of these cases with the mortality rates of the English Life Table No. 8, shows that persons admitted to the sanatorium in the incipient state of the disease furnished five to six times as many deaths as would have occurred in an average sample of the population; moderately advanced cases 15 to 20 times as many. A series of detailed tabulations indicate that the smallest excess mortality is among those patients discharged when the disease appeared to be arrested; that the mortality is lighter in those cases in which the chief initial symptom is hemoptysis, than when the onset is more insidious; that disappearance of the tubercle bacilli from the sputum is correlated with a lower rate of after mortality; that a family history of tuberculosis did not appear to affect the prognosis. A special chapter devoted to a comparison between ordinary sanatorium treatment and sanatorium treatment combined with the use of tuberculin reveals no appreciable effect for good or ill exerted by the tuberculin. The total number of observations being less than 2000, the sub-tabulations reach numbers so small, that many of the author's detailed conclusions will need verification; but the main conclusion that the death rate of persons discharged from the sanatorium is a good deal higher than the average death rate is not likely to be questioned. To indicate the real value of sanatorium treatment comparison should be made between sanatorium patients and those from the same social class treated on different lines. No such data are available.—*The Mortality of the Tuberculous after Sanatorium Treatment, Editorial, Brit. M. J., September 27, 1919, No. 3065, 417.*

Treatment of Dysphagia in Laryngeal Tuberculosis.—An appeal is made to practitioners in general to relieve their patients with tuberculous laryngitis by blocking the superior laryngeal nerve and thus doing away with the painful dysphagia. In an extensive experience at the Lariboisière Hospital with this class of patient, the relief has been constant. The injection of alcohol to block the superior laryngeal is simple and easy, owing to the superficial course of this nerve. The nerve is located by the cornua of the thyroid and of the hyoid bone, and the injection of a few drops of alcohol along its course blocks it completely, and in some cases definitely. There is a sharp pain at once, especially if cold alcohol is used, but it subsides in a few seconds as the nerve becomes blocked. The edema and infiltration retrogress and the patient can eat without dread of pain. A single bilateral injection

answered the purpose in some cases; others required a new injection in five or ten days, but permanent anesthesia was finally realized after a few injections. Seven was the maximum. With the patient seated in front of him, Halphen pushes with two fingers the larynx toward the right with the left hand, and explores with his thumb the groove between the thyroid and hyoid bone on the right side. Holding the thumb there, he introduces the needle on a line joining the two cornua, first perpendicularly, then parallel to the hyoid bone, 1 cm. toward the median line. The thumb feels the needle making its way under the skin between the two landmarks. Then the needle is lightly pushed in deeper as the plunger is worked. A sharp violent pain shows that the nerve has been reached. The cricothyroid membrane must be left unmolested.—*Du traitement de la dysphagie dans les laryngites tuberculeuses par l'alcoolisation du larynge superieur, E. Halphen, Paris Méd., October 11, 1919, ix, No. 41, 296.*

Diet in Tuberculosis.—The time of forced feeding in tuberculosis has passed, but there is still a tendency to overfeeding. At the Westfield State Sanatorium the custom of giving raw eggs between meals was abolished long ago, and for the past year no milk has been served between meals. Other sanatoria have also adopted a no-lunch policy. Experience shows that lunches should be served to adult patients only as a special prescription for an unusual condition. It is necessary that food be of good quality, prepared in an appetizing way, and well served; but it is of the greatest importance that it appeal to the taste of the individual patient, and it is therefore essential to offer a variety at each meal. The Westfield Sanatorium has solved this problem by adopting a cafeteria system, allowing the patients a considerable latitude of choice. The results of this policy are that the patients have gained as much or more than under the old system; there has been a noticeable decrease in digestive disturbances; the patients relish their meals and feel that they are getting sufficient nourishment; there is a considerable saving in food cost.—*Diet in Tuberculosis, R. Morgan, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 252.*

Diet in Tuberculosis.—There is no disease that so taxes the resources of the dietitian as tuberculosis. Many conditions cause loss of appetite which makes proper feeding all the more difficult. All foods should be of the first quality, well cooked, and attractively served. A reasonable variety is essential; the diet should be well balanced with a relatively large increase of protein and a considerable increase of fats. Most authorities agree that a tuberculous patient ought to have from 3000 to 4500 calories daily, but many of the advanced types cannot take care of more than 2000. Under the head of proteins, milk comes first; at least one quart should be taken daily; it may be given mid-morning and afternoon to patients who eat well at mealtime. At times sour milk preparations may be used. Eggs occupy a position second only to milk in nutritive value and ease of assimilation; they can be served in a variety of ways except frying. Meat comes third in the dietary of the tuberculous; for vegetable protein, peas, lentils and beans may be used. The foods yielding the highest percentages of carbohydrates are arrowroot, tapioca, corn and rice, honey, sago, wheat flour, toasted bread; dried peas and lentils; certain fruits. The chief fats are butter, bacon, cheese, and some nuts. Sugar is a valuable addition on account of its high caloric content. The limits of each patient's digestion must be carefully considered; but it seems best to give more attention to the palatability of the food and less to its caloric value. The patient will eat more and digest more easily if the food is relished. A sample menu of the Haverhill Sanatorium for a week is given. This provides for three meals a day. —*Diet in Tuberculosis, I. J. Clarke, Boston M. & S. J., August 28, 1919, clxxxi, No. 9, 249.*

Open Air Classes.—Marcus describes the work of the Bureau of Child Hygiene of the New York Department of Health and especially the establishment of open air classes in the public schools. They were organized to provide special opportunities for the physically subnormal children after an experimental open air class had been tried. There are now 110 of these at present located on the roofs of the school buildings, in public parks, etc. Experience has proved that in a large city these classes are best placed in the school building. The roofs require the climbing of too many stairs. The public parks would be an ideal location but for the expense of the buildings required. When the school house is originally constructed little additional cost would be incurred for accommodation of one or more open air classes. The following types of children are admitted: those who have had tuberculosis or been exposed to it; those suffering from malnutrition; children who show little stamina and become tired easily and are unable to carry on their class work; children suffering from nervous diseases except chorea; those sub-

ject to colds, bronchitis, etc., and heart disease cases when recommended by a physician. The important factors in the success of the work are fresh cool air, light food, correction of physical defects retarding growth and proper hygienic living conditions. These are all provided for during the school session. It has been found that no temperature is too low provided the children are properly protected, and the increase in weight occurs during the colder months. Extra feeding is always provided between meals if possible, and frequent short recesses for recreation are given. Rest periods from 1 to 1:10 p.m. are given to classes on the upper floors. Proper hygienic conditions at the homes are a difficulty and require much social service work. A poor teacher or one not physically strong is a great handicap to an open air class, as much of the success of the work depends on her. The results from all the open air class work has been so satisfactory in the way of improving health, habits, etc., that the average children would give the same or better results if put under the same conditions.—*Open Air Classes, L. Marcus, J. Am. M. Ass., October 4, 1919, lxxiii, No. 14, 1057.*

Heat and Tuberculosis.—Gauss studied the effects of high temperature during the hot spell of July, 1916, on the patients in Cook County Hospital, Chicago, with special reference to the effect on tuberculosis cases. The normal man is supposed to stand the excessive heat strain. For heat stroke it is not unlikely that heat, pure and simple, is the chief factor. During July, 1916, there were admitted to Cook County Hospital 158 patients suffering from heat stroke and exhaustion. But independent of those admitted as frank heat cases, rises of temperature were observed in other patients, greater than might have been expected in the ordinary course of their diseases. In the tuberculosis ward seven patients had temperatures 2 to 3°F. above that due to the usual course of the disease which corresponded in time with the principal heat wave. Similar observations were made in other diseases, but the tuberculous were taken for special study. Most of them had chronic advanced tuberculosis, and their fever tended to run an even protracted course without marked irregularities. The history of every case in this ward was examined and their temperature records were noted for the hottest five days, and the five days preceding and following. Fifty-six cases were thus observed, and their morning and afternoon temperatures for each day were averaged and plotted. In the five days preceding the heat wave, July 20 to 25, the average afternoon temperature varied between 99.5° to 100°F., in the five days of the heat wave, July 26 to 30, the afternoon temperatures varied from 100.5° to 100.8°F. and in the five days after the heat wave the afternoon temperatures varied between 99.7° and 100°F. The striking fact is that during the heat wave the average afternoon temperature was 100.62°F. as compared to 99.8° and 99.86°F. for similar periods preceding and following it. The increased temperature during the foregoing period was probably caused by the high air temperatures and unfavorable air conditions.—*The Influence of High Air Temperature on Tuberculosis, H. Gauss, J. Am. M. Ass., October 11, 1919, lxxiii, No. 15, 1135.*

Artificial Pneumothorax.—The typical indication for artificial pneumothorax is the presence of a process tending to caseate, progressive, ulcerative, unilateral, of recent duration and accompanied by fever, in a middle aged subject. The presence or absence of adhesions of the pleura and their extent must be ascertained. In two out of three cases inflation will prove impossible of accomplishment. In three cases where inflation is successful complete pneumothorax will result only in two cases, the third being only partial. Observation of the manometer will show when the pleural cavity has been penetrated by sharp oscillations synchronous with the respiratory movements; when the oscillations fail to appear it may mean that the needle has become clogged while passing through the parietes or that the needle has not yet reached the cavity or that it has already penetrated the lung. In the latter cases a descent of the column of water in the manometer during a prolonged inspiration will be noticed. The most common accidents are subcutaneous emphysema, which is of little importance; severe pains, which can often be avoided but which may be due to the tearing apart of adhesions in which case caution in increasing the gas pressure is imperative. Very severe cerebral symptoms may appear. They are ascribed by some to gas emboli but appear to be rather of reflex origin. The use of too great pressure of gas while attempting to sever adhesions is often followed by cerebral symptoms such as contractures, palsies, and vasomotor disturbances. This practice is therefore dangerous. Rupture of the pleura with the formation of a pyopneumothorax is one of the more serious complications but fortunately rare. What is more common is a serous effusion, sometimes becoming purulent, which while not very serious per se has a retarding influence on the cure and influences the course of treatment. The results of artificial pneumothorax are a diminu-

tion in the expectoration and cough, disappearance of bacilli, decrease in dyspnea and all the other symptoms such as the anorexia, night-sweats, etc. Autopsies performed on subjects who had undergone prolonged treatment with artificial pneumothorax showed distinctly the formation of connective tissue in the affected parts of the lung. Of course, the procedure being only a local measure, general hygiene and all the measures which go to build up body resistance against the tubercle bacillus in the lungs and other organs must continue to be the principal part of the treatment of tuberculosis.—*Le pneumothorax artificiel en thérapeutique. Sa technique, ses complications, ses résultats cliniques et anatomiques, J. Bertier. Progr. Méd., July 12, 1919, No. 28, 272.*

Simplified Pneumothorax Method.—Certain disadvantages adhere to the two-puncture method of inducing therapeutic pneumothorax, such as the possibility of air embolus in a vein and the possibility of introducing unfiltered air through the exposed lumen of the needle. A simpler method consists in using a two-way stopcock between the syringe and needle employed for injecting a local anesthetic. One end of this stopcock fits the point of the syringe and the other end fits the needle. A branch extends from the side of the stopcock to which can be attached a rubber tubing leading to the gas apparatus. The stopcock is also provided with a two-way valve, so that when it is turned one way the needle connects with the syringe for drawing up and injecting the local anesthetic, and when turned the other way it communicates with the side branch leading to the gas apparatus. The advantages are summed up as follows: (1) The operation is rendered much simpler and easier. (2) The amount of trauma to the pleura is greatly minimized, and so pleural shock is less likely to occur. Though the cause of pleural shock is not well known, yet judging from what is known about shock in general, it is reasonable to suppose that pleural shock is less likely to occur when the pleura is punctured with a small needle than when it is pierced with a dull trocar and canula. (3) Subcutaneous emphysema is less frequent. (4) The patients do not dread the operation so much when this method is used, as they consider it of a minor character, and it is well known that the state of mind of the patient is an important factor in the success of the treatment. The apparatus is illustrated.—*A Simplified Method for Inducing Therapeutic Pneumothorax, J. Rosenblatt, J. Am. M. Ass., December 6, 1919, lxxiii, No. 23, 1766.*

Artificial Pneumothorax.—In fifteen cases of induced pneumothorax in the last seven years, the immediate effects were excellent, but the ultimate outcome was far from satisfactory. The long rest of the lung did not seem to have improved the general condition on the whole, and the disease finally progressed as in cases in which this collapse therapy had not been applied.—*Ervaningen met den Kunstmatigen Pneumothorax, B. H. Vos, Nederl. Tijdschr. v. Geneesk., September 13, 1919, ii, No. 11, 713.*

Chemotherapy.—Having observed in previous experiments that xylol had an effect on tuberculous processes, Volpino instituted a series of experiments to test more accurately the action of the substance. His first experiments in this direction were made on twelve guinea pigs, all of about the same weight, and all inoculated with tuberculous sputum fairly rich in bacilli. Four days after infection, six of the guinea pigs were submitted to periodic injections of xylol, the other six animals being kept as controls. One of the six guinea pigs receiving the injections of xylol died on the twenty-fifth day (probably from intoxication), without presenting any post mortem lesions other than a very small nodule in the peritoneum. The other five animals developed very trifling increase in size of the palpable lymph glands, and, when killed forty-six days after infection, presented much less marked internal lesions than were found in the control animals. Further experiments showed that if the xylol injections were begun in guinea pigs, not too seriously infected, on the eighth to tenth day after infection, it was possible to keep these animals alive until the fortieth day without the manifestation of more than limited signs of infection. Whereas, in control animals, very visible external and very wide-spread internal lesions developed by the fifteenth or eighteenth day after infection. Other hydrocarbons (toluene, cumene, etc.) were similarly tested with somewhat similar results. Curative treatment by the intramuscular injection of xylol and cumene (trimethylbenzene) has also been tried in the human subject with encouraging results. The injections were first made in doses of 0.5 to 1 cc. of the undiluted drug, but this was found to induce local pain and some fever. More frequent doses of the hydrocarbon diluted to 10 per cent with sterilized olive oil could be made without the production of either pain or fever.—*Étude expérimentale sur la thérapie de la tuberculose, G. Volpino, Ann. Inst. Pasteur, March 1919, xxxiii, No. 3, 191.*

Passive Anaphylaxis for the Recognition of Tuberculous Meat.—The experimental observations of the author have shown that the muscle plasma of cattle affected with tuberculosis, in an advanced or medium degree, injected once into rabbits, induces a condition of hypersensibility, so that subsequent injection of tuberculin produces passive anaphylaxis of a grave character. This reaction may be regarded as specific, because control rabbits, injected with muscle plasma of healthy cattle, do not react, or present very slight disturbance. The anaphylactic state may be transmitted to other healthy rabbits, but the condition is less intense. In both cases the passive anaphylaxis is accompanied by hyperthermia. The reaction may be of use to meat inspectors who have to determine whether meat is tuberculous in cases where the viscera are not available, and where the lymph glands of the part are not involved.—*L'anafilassi passiva per riconoscimento delle carni tubercolotiche, L. Granucci, La Clin. Vet., February 28, 1919, xlii, No. 4, 115.*

Arsenic in Tuberculosis.—Arsenic has almost unlimited alterative value and is indicated in tuberculosis and in anemia. The form to be selected is one that is most easily assimilated and least cumulative in its effects. Sodium cacodylate is the salt that best fulfills these conditions; it should be given hypodermically in concentrated, nonvoluminous solution. Dosage is governed by the age and condition of the patient and the frequency of administration; the dose may vary from one grain to two grains or more. It is best given at frequent intervals, at least twice a week. The solution should always be warmed to body temperature. One case of intestinal tuberculosis is reported in a woman aged forty-two, who under treatment with sodium cacodylate, improved so greatly that she could return to work.—*Arsenic in Tuberculosis and Anemia, A. R. Caron, N. York M. J., September 20, 1919, cx, No. 12, 513.*

Treatment of Pulmonary Tuberculosis with Saccharose.—The author tried in Amrein's sanatorium Lo Monaco's injections of saccharose in nine patients who had profuse expectoration, and in whom the physical findings appeared to be stationary. The only apparent effect obtained was a reduction in the amount of the expectoration in many of the patients. The degree by which the amount of sputum was reduced varied from 20 to 80 per cent. Care and accurate observations of the patients are needful in this treatment, for it is not borne well by all.—*Zur Behandlung der Lungentuberkulose mit Saccharose, P. v. Schulthess-Rechberg, Corr. Bl. f. Schweiz. Aerzte, April 12, 1919, xlix, No. 15, 484.*

Heteroserotherapy in Pulmonary Tuberculosis.—An attack of acute pleurisy in the course of chronic pulmonary tuberculosis with absorption of the effused fluid is not infrequently followed by marked amelioration of symptoms. This improvement has been ascribed by some to the mechanical action of the fluid in compressing and immobilizing the subjacent lung, but this explanation is not regarded as satisfactory. It is more probable that the effusion increases the resistance of the patient by a form of autoserotherapy. The authors in 1917–18 treated 8 cases of chronic pulmonary tuberculosis by a method of heteroserotherapy. Fluid from five cases of pleurisy was used—two cases of primary tuberculous pleurisy with effusion, three cases of acute pleurisy with effusion complicating open pulmonary tuberculosis. The effused fluid was withdrawn from the donors' chests with aseptic precautions into flasks containing a 2 per cent solution of sodium citrate in normal saline, the final proportion of pleural fluid to citrated saline being roughly as 3 to 1. In some instances a rough estimation of the number of lymphocytes per cubic centimeter was made. The fluid was sterilized by adding one-tenth its volume of 5 per cent phenol stirring in slowly and was stored in the cold. It was administered by subcutaneous injection, the initial dose being small, 1 to 2 cc., increased gradually to 10, 15 or even 25 cc. At first injections were given two or three times weekly, later when the larger doses were reached, at weekly intervals. Occasionally a slight transient rise in temperature was noted, but no other reaction. All the cases treated, with the exception of case D, had extensive active disease of the lung; in every instance tubercle bacilli were present in the sputum. In three of the cases the treatment had no apparent effect; in two, where improvement coincided with treatment, there had been signs of improvement before it was commenced. Two cases who were going steadily downhill in spite of other measures, showed rapid and marked improvement; in the remaining case (D), where the patient's general condition was good, troublesome symptoms that had persisted for months disappeared. The authors conclude that heteroserotherapy is worthy of further investigation.—*"Heteroserotherapy" in Pulmonary Tuberculosis, J. J. Perkins, R. A. Young & W. O. Meek, Lancet, September 27, 1919, No. 5013, 556.*

Tuberculosis Vaccine.—Vaccine prepared by von Ruck was employed in 41 cases of tuberculosis. Twenty-four were charity cases and 17 private. Of the former, there were 14 apparent recoveries, 7 greatly improved, 2 improved, and 1 failure. Of the private cases, 13 were early cases and all apparently recovered; 4 advanced cases also apparently recovered; the remaining two cases improved. A series of experiments on guinea pigs also showed that the animals can be protected against a mild infection with living tubercle bacilli by the administration of the vaccine, and that the active serum taken from human subjects after treatment, or after prophylactic vaccination with the same vaccine, acquires a higher degree of germicidal action upon living tubercle bacilli than is present in normal or tuberculous persons.—*Specific Treatment of Tuberculosis, G. T. Brown, Therap. Gaz., May 15, 1919.*

Defensive Ferments in Tuberculin Therapy.—Dargallo explains all tuberculin reactions as an anaphylactic shock brought about by the union of a preformed defensive ferment with a foreign protein, the tuberculin. The active substance in tuberculin is always one and the same, a protein of the tubercle bacillus, or the endotoxin of the same. This substance in the tuberculin, ejected from the focus, or injected from without, gives rise in the body to the formation of antibodies, thus causing a modified immunity or sensitization. These antibodies, described by Wolff-Eisner as lysins, are the same as the defensive ferments of Turros and the author. These preformed ferments, of cellular origin, will attack and digest the less toxic protein contained in the tuberculin, splitting it into minute and highly toxic molecules (Eber's Tuberculopirine, or the Tuberculolysin of Wolff-Eisner) and thus causing anaphylactic shock. This theory explains the local, focal and general reactions.—*Los Fermentos Defensivos en la Tuberculoterapia, R. Dargallo, Arch. Espan. d. Tisiologia, January 1919, i, No. 1, 79.*

Culture of the Tetanus Bacillus in the Presence of Tuberculin.—1. From the results of his experiments Marino concludes that a culture medium containing 1 mgm. of tuberculin per cubic centimeter never permits the growth of the tetanus bacillus. This suggests a very convenient method of estimation of the amount of tuberculin present in a culture of the tubercle bacillus. Ten cubic centimeters of the filtrate of a tuberculous culture is placed in a test tube and sown with tetanus bacillus. If the tetanus bacillus, under anaerobic conditions, does not grow, it may be concluded that at least 1 mgm. of tuberculin per cubic centimeter is present. In order to estimate the amount of tuberculin more exactly, ten tubes are taken, and in them is placed a quantity of filtrate increasing from 1 to 10 cc., along with ordinary bouillon decreasing in amount from 9 to 1 cc. The tubes are then sown with the bacillus of tetanus, and rendered anaerobic. 2. Following up the above method, Marino discovered that antituberculous serum and normal serum, in general, neutralize tuberculin without any difference, both permitting the growth of the tetanus bacillus at the end of forty-eight hours. Sometimes one may even find that normal serum neutralizes tuberculin better than does antituberculous serum, permitting the growth of the tetanus bacillus at the end of forty-eight hours, while the specific serum may not permit growth until the end of the third or fourth day. 3. Using the same method, Marino found that the human and bovine types of tubercle bacillus permitted the growth of the tetanus bacillus up to the thirtieth to thirty-fifth day, while the equine type of the tubercle bacillus permitted the development of the tetanus bacillus up to the fiftieth day. The amount of tuberculin in cultures of human and bovine bacilli was always greater than in cultures of the equine bacilli of the same age.—(*1*) *De la culture du bacille du tétanos en présence de la tuberculine, F. Marino, Revista Hig. y Sanidad Pecuarias, Madrid, June 1919, ix, No. 6, 349. De la culture du bacille tétanique en présence de la tubérculine. Procédé de dosage de la tuberculine, F. Marino, C. R. Soc. Biol., Paris, July 12, 1919, lxxxii, No. 22, 821.* (*2*) *De la culture du bacille tétanique en présence de la tuberculine. Détermination du pouvoir antitoxique des serums antituberculeux, F. Marino, Ibid, 823.* (*3*) *De la culture du B. tétanique en présence de la tuberculine, F. Marino, Ibid, 831* (*from Vet. Rev., November 1919, iii, No. 4*).

Outcome with Surgical Tuberculosis.—The authors report on the present condition of 537 patients given operative treatment at Basel in 1913. The data presented show that tuberculous processes in fingers, toes, wrists, glands, tendons, soft parts and skin can be successfully treated almost anywhere. With tuberculous lesions in ribs, sternum, clavicle, scapula, radius or ulna, urogenital organs, intestines or peritoneum, one is justified in applying treatment in the mountains or the lowlands as most convenient. But treatment in a mountain climate is extremely desirable with tuberculous lesions in the spine, pelvis, humerus, shoulder, femur, tibia or fibula, and in the hip, knee

and ankle joints. The advantages of a mountain climate in this group are evident in the figures, and the necessity for a mountain sanatorium for this group as an annex to other hospitals is urged. For the whole of Switzerland, probably one-fifth of the average 15,000 cases of surgical tuberculosis require altitude treatment in addition to the other measures. The aim should be therefore to provide mountain sanatorium accommodations for these 3000 that require it, with a system of interchanges between sanatoriums and hospitals to give this special group the advantages of altitude. Even those patients already living in the mountains need the care and training of a sanatorium. The course of treatment with surgical tuberculosis usually takes one or more years while the course with pulmonary tuberculosis is generally restricted to a few months. As children form the large contingent of surgical tuberculosis cases the loss of time does not matter so much. The system of sanatoriums should be supplemented with institutions where the convalescent and recovered should be gradually accustomed to resume work and train for future activity under medical supervision. There should be a kind of employment bureau in connection, designed for these more or less handicapped persons.—*Die Statistik der chirurgischen Tuberkulosen in Basel fur das Jahr 1913, F. de Quervain & H. Hunziker, Corr. Bl. f. Schweiz. Aerzte, May 24, 1919, xlix, No. 21, 761.*

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The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page.

Drugs in Tuberculosis.—It is now generally recognized that drugs occupy a secondary place in the treatment of tuberculosis but unfortunately, it has been forgotten that they also occupy a necessary place. Without proper dietetic and hygienic management, drugs are of small service. On the other hand, recovery is often not complete and not maintained without them. The relative failure of sanatorium treatment is to be attributed to the neglect of their powerful aid. Two groups of remedies have "stood the test of time;" namely, certain iodin compounds, and creosote and its congeners. The use of calcium, introduced on the somewhat crude basis that calcification and fibrosis are the natural methods of healing of tubercles and tuberculous ulceration, is also commended. These drugs help tuberculous patients to recover and to stay "well." Iodin in the infiltrative stage; phenol, creosote or guaiacol for use in the more advanced stage, or in the presence of fever; and calcium for use throughout, are, although secondary, nevertheless necessary agents in the successful management of the great mass of cases of chronic pulmonary tuberculosis. They are to be used freely—with discretion to be sure, and with individualization—but also with persistence.—*The Place of Drugs in Tuberculosis. S. Solis-Cohen, Penna. M. J., October 1919, xxiii, No. 11.*

Treatment of Syphilis in Tuberculous Patients.—It is a not uncommon occurrence to find both a syphilitic and tuberculous infection in the same person. The literature is full of data as to the incidence of tuberculosis among syphilitics. The various investigators, however, worked on markedly different material, causing percentages to vary considerably. Tedeschi reports that 70 per cent of the cases of tuberculosis developing during a period of ten years in his prison service occurred on luetic soil. The other investigators' figures vary from 5 to 43 per cent. Bronfenbrenner attributes the frequency of tuberculosis among syphilitics to the syphilis as such or to the antisyphilitic treatment lowering the resistance of the patient so as to make him more susceptible to a new infection of tuberculosis or render him less resistant against the progress of the disease already contracted. He refers to the enthusiasm many clinicians showed, a few years ago, following a report that tuberculosis was greatly benefited by mercurial injections. The author states this report was a little premature as it was shown that these patients who showed improvement had syphilis also and that results were only temporary. According to Hartz and other observers, mercury was shown to be detrimental to patients with tuberculosis. With the advent of salvarsan many optimistic results have been reported.

The author's experience does not verify this. He gives many case reports of patients with a dual infection treated with arsphenamine alone and comes to the following conclusions: Mercury should be used with great caution in tuberculous patients. The deleterious effect is not immediate but appears months later as pointed out by Hartz. Arsphenamine is the drug of choice but should be given in small doses at long intervals as in his experience the ordinary dose accentuates active foci and is proved to cause a flare up in latent lesions.—*The Treatment of Syphilis in Tuberculous Patients, J. A. Elliott, Am. J. Syph., April 1919, iii, No. 2, 291.*

Treatment of Chronic Cough.—Voorhees classifies the causes of chronic cough under three heads: (1) mechanical irritation of the vagus; (2) bacterial infection somewhere along the path of the airways; (3) sensitization to protein toxin and to pollens. Mechanical causes are new growths, enlarged glands, diseased tonsils, aneurysm, elongated uvula; foreign body in the trachea, bronchi or lungs. Bacteria may include not only the pneumococcus, the tubercle bacillus, but even the common bacteria involved in ordinary colds. Foreign proteins may be from horse dandruff, chicken feathers, the hair of dogs, cats, mice, and rabbits; food proteins such as egg, lobster, veal, etc. If mechanical and sensitization causes can both be excluded then we have to deal chiefly with the activities of pus forming microörganisms. In such event an autogenous vaccine may be of great service in treatment, and acidosis must be guarded against by the administration of sodium bicarbonate, sodium citrate, and other alkalies in large doses plus the acid fruits. General tonics may be used with good effect, and of these strychnine is especially useful since it acts almost specifically on relaxed mucous membranes. Finally, antiseptic agents must be judiciously employed, as the silver salts, or the oily antiseptics, such as menthol in oil, thymol, oil of cloves, in from 5 to 25 per cent solution, 1 cc. being introduced into the trachea at each sitting and allowed to gravitate into the affected bronchus by the patient lying down on the side in question. Dichloramine-T in chlorcosane oil is one of the most active antiseptics for chronic infections and the only precautions to be observed are that the liquid be fresh, neither acid nor alkaline, free from foreign matter, and that it reach the free exposed surface where the bacteria are supposed to be. To succeed, the patient must be willing to have the X-ray and other tests which may be necessary.—*Causes, Diagnosis and Treatment of Chronic Cough, T. W. Voorhees, Am. Med., October 1919, xiv, No. 10, 635.*

The Surgical Treatment of Tuberculous Stenosis of the Larynx.—In the majority of cases, laryngeal stenosis is not a complication, but rather a clinical manifestation occurring during the ordinary evolution of tuberculosis of the larynx. The stenosis almost invariably progresses slowly and it is only at the ultimate phase of the process that a rapid progress of the lesion occurs which ends fatally. From the viewpoint of treatment, tuberculosis of the larynx is no longer a fatal affection. Unquestionably, local medical treatment may be very useful in certain cases and inhalations, fumigations and sprayings are precious adjuvants to the general antituberculous treatment. The same may be said of rest cures, climatotherapy and heliotherapy. But these therapeutic measures are often unsuccessful. The galvanocautery and the curette can be employed without danger in tuberculous lesions of the larynx and thyrotomy has been resorted to in order better to reach the stenosing lesions with these instruments. In a certain number of instances the results obtained have been good, but occasionally success has not been as favorable as might have been expected for the reason that complications have ensued. It seems necessary to determine the indications for other surgical procedures in tuberculous laryngeal stenosis. When the patient's general health is good or satisfactory, when the pulmonary lesions are limited in extent and follow a slow evolution, removal of the tuberculous granulations with the curette, cautery or cutting forceps by the endolaryngeal route may be attempted.

In a certain number of extremely favorable cases, a kind of radical cure may be essayed by the exolaryngeal route. By this technic tracheotomy, laryngectomy, laryngo-fissure or laryngostomy can be resorted to. The three latter operations have undoubtedly resulted successfully, but they have also been followed by numerous unsuccessful results in that cicatricial recurrence has taken place and for this reason considerable reserve should be maintained in regard to their real value. Tracheotomy alone is especially indicated in cases of stenosis of the larynx, the low operation being preferable, because it does not involve division of the cartilages and also because it will not compromise the success of further operations on the larynx. When the case is urgent, epiglottectomy should be done to relieve the dyspnea.—*Editorial, N. York M. J., March 20, 1920, cxi, 512.*

Tuberculin Treatment of Asthma Due to Tuberculous Glands.—Asthma from hilum and perihilum tuberculosis is common in childhood; asthma of this type is probably a form of anaphylaxis or allergy

toward the toxin of the tubercle bacillus. In a good percentage of cases tuberculin treatment rapidly improves the morbid process or even produces a radical cure. This improvement is much more rapid than in cases treated without tuberculin. Of course tuberculin is used in conjunction with other therapeutic measures.—*Tratamiento del asma ganglionar tuberculoso por la tuberculina, L. V. Blanco, Semana Med., June 12, 1919, xxvi, 624.*

X-rays in Tuberculous Adenitis.—Surgery alone in tuberculous adenitis does not usually give satisfactory results. Results in early cases with radium are undoubtedly good, but equally good results can be obtained with the X-rays, which are usually more easily available. X-ray treatment alone will cure the very early case, but it is usually best to operate when all periglandular inflammation has subsided and the glands can be detected only on careful palpation,—usually after six to eight weeks' X-ray treatment. If this is not done a considerable number of apparent cures relapse. Where softening is already present treatment should be surgical, followed by the X-rays very soon after operation. Discharging sinuses thus treated heal in a few weeks.—*X-rays in Treatment of Tuberculous Adenitis, F. Hernaman-Johnson, Brit. M. J., December 20, 1919, 812.*

Tuberculin.—Recent literature shows that most observers consider tuberculin of great assistance in pulmonary tuberculosis. Some observers are more conservative in their estimate of the value of tuberculin. Tuberculin has not been used extensively in the treatment of bone and joint tuberculosis, and by few orthopedic surgeons. Some believe that tuberculin in small doses at proper intervals is of undoubted value in the treatment of selected cases of tuberculous bone and joint infections. Others consider it to be of decided value in the treatment of tuberculous joints and that it can be administered during any stage of the disease. Tuberculin has not been given a sufficiently long or extensive trial in orthopedic cases and criticism in such cases would be unfair. Furthermore, the orthopedists had used tuberculin in either single, fairly large doses, or had repeated the same dose at short intervals. In this way they frequently got severe constitutional reactions. The belief has grown that for therapeutic purposes tuberculin should be given in increasing doses and regulated so as to avoid a reaction. For the proper management and treatment of a case of bone and joint tuberculosis with tuberculin, there were three essential factors: First, a correct diagnosis; second, a thorough knowledge of the symptoms, course of the disease, and probable complications; third, an accurate knowledge of the dose of tuberculin and its action. Tuberculin may be very toxic, and if unwisely or improperly administered harm may result. The patient may die. Great care must be exercised. It is argued that subcutaneous injections in increasing doses, beginning with small innocuous quantities, will cause the production of substances in the blood that will destroy or lysinize the tubercle bacilli. If the tuberculin is given in increasing and properly regulated doses the tubercle bacilli will gradually be killed and the patient will become resistant to tuberculous invasion through loss of hypersusceptibility to tubercle bacilli. Patients who receive tuberculin and do not receive orthopedic treatment are never cured. In a series of cases tuberculin was administered to the patients while they received orthopedic treatment. It was found that the patients were not cured by the administration of tuberculin. Not a single case was entirely successful. Tuberculin produced a tolerance for tuberculin and not for the tubercle bacillus or all of its toxins. The conclusions arrived at are: (1) Tuberculin does not cure tuberculosis of the bones and joints. (2) In the majority of cases, tuberculin therapy causes no noticeable beneficial influence upon the bone or joint lesion. (3) In a small proportion of cases there has been an improvement of the lesion. (4) In some cases there may be a distinct accentuation of the disease. (5) New abscesses may appear during and after completion of tuberculin treatment. (6) Relapses occur after apparent improvement.—*Tuberculin, S. Kleinberg, J. Orthop. Surg., December 1919, i, No. 12, 722.*

Tuberculin in Minutest Doses.—Only the minutest doses, long kept up, are effectual; the ordinary large doses used by others do actual damage. Success with these minutest doses is not confined to pulmonary tuberculosis but Poncet's "chronic tuberculous rheumatism" subsides under it likewise, and a number of other lesions and morbid conditions which have never been connected with tuberculosis hitherto. Their disappearance under this method of treatment throws new light on their etiology, so that this "tuberculin diagnostic-therapeutic test," is opening new fields for research and effectual treatment. It has proved exceptionally useful for the new recruits, disclosing those who already are infected even slightly, and enabling them to throw off the infection, while they are

spared the inconvenience and disappointments from futile treatment on other grounds. He has found the minute doses extremely useful further to stimulate the vital forces in advanced pulmonary tuberculosis, as, for instance, when artificial pneumothorax has ceased to prove effectual. The dose has been too large whenever disturbances of any kind follow. The No. 00 "ultrasmall dose" is 0.05 cc. of a 100,000,000 solution. The next lower strength is made with one part of this solution and nine parts distilled water containing $\frac{1}{4}$ per cent phenol. Further dilutions are made in the same way down to quintillions or beyond. The optimal dose is that followed by frank improvement in the morbid picture. The first improvement is usually transient, and the reappearance of symptoms is the signal for a new injection. It should never be made before the benefit from the preceding injection begins to decline. As treatment continues, the benefit is seen to be more and more lasting each time, demonstrating an actual cumulative beneficial action. There can thus be no regularity in the dates of the injections. The intervals vary from case to case and at different periods in the same patient. We see surprising benefit from tuberculin treatment in these minute doses in many morbid conditions which have never been supposed before to have any connection with tuberculosis. Their complete subsidence under this method of treatment certainly suggests that tuberculosis is one factor if not the only one. This group includes not only apical cases, but cases of peritonitis, pericolitis, enteritis in members of tuberculous families, joint, glandular and gastro-intestinal lesions, endocrine disturbances, etc. The tuberculin treatment reveals the tuberculous nature of the morbid process and often proceeds to cure it. In a case of unilateral optic neuritis, for instance, this treatment induced marked improvement and the presumptive diagnosis was confirmed by discovery of a minute tubercle close to the entrance of the optic nerve into the eye. Continuing the tuberculin treatment resulted in the complete subsidence of the lesion and recovery of vision. Both clinical, operative and necropsy findings have confirmed the tuberculous nature of this great variety of morbid conditions which show such marked improvement under these courses of minute doses of tuberculin. As long as appreciable improvement is manifest the same dose must be repeated indefinitely, merely "marking time to keep step," as it were.—*Sobre la prueba diagnostico, terapeutico de la tuberculina, J. J. Vitón, Sem. Med., July 10, 1919, xxvi, No. 28, 29.*

The Administration of Tuberculins.—Tuberculin has proved a valuable adjunct in the treatment of tuberculosis. It ought to be administered carefully, and only by one who is thoroughly familiar with its action and effects upon the tuberculous body. The initial doses should be smaller and the interval between doses longer in active cases. The clinical method of giving tuberculin is not always free from danger, because of the possibility of overstimulation, the only gauge indicating the approach of the overtolerant dose being the appearance of fever, headache, and pain. Another unfavorable factor for the clinical method is the likelihood of not causing any stimulation in the tuberculous foci if the doses are not increased rapidly enough, or if the interval between doses is too remote. The neutrophilic index may be used as the guide to the proper dose of tuberculin by the following method: If the neutrophilic index is 94, that is 94 per cent of polynuclear neutrophile leucocytes, with one solid lobule, and 6 per cent of polynuclear neutrophile leucocytes with two separate and distinct lobules, then give tuberculin. If the neutrophilic index is very low, 80 to 92, that is, 80 to 92 per cent of polynuclear neutrophile leucocytes, with one solid lobule and 20 to 8 per cent of polynuclear neutrophile leucocytes with two or more distinctly separate lobules, double the previous dose. If the index is repeatedly 94, increase the dose by one, two, or more tenths, according to the repeated index at 94. Never give tuberculin if the neutrophilic index is 96 or above, that is, 96 per cent of polynuclear neutrophile leucocytes with one solid lobule, and 4 per cent only of polynuclear neutrophile leucocytes with two or more lobules distinctly separate. By this method the dangers of tuberculin are eliminated and the best results are derived. We have a fair gauge when to start it, when to repeat or increase the dose, and especially when not to give it at all.—*The Administration of Tuberculins, W. J. Durel, New Orleans M. & S. J., October 1919, lxxii, No. 4, 164.*

Vaccination Against Tuberculosis.—Maragliano brings down to date his report on the vaccination of children and others against tuberculosis, which he has been advocating for twenty-five years. He aims to produce a minute focus by subcutaneous injection of dead tubercle bacilli, theorizing that in this focus antigens will be produced and that they will pass into the circulation from this focus, thus slowly and progressively inducing the production in the body of immunizing materials. His clinical and biologic tests have demonstrated that this

production of antibodies does actually occur. Research now under way with Sivori's modification of the fixation reaction test has shown an appreciable reaction in healthy persons in two weeks after the vaccination: First the antigens show up more and more while the antibodies are scanty; then the antibodies become more and more evident by the end of one and two months, and they become very pronounced by the end of the third month. Then the antibodies show an ascending curve while the antigen curve keeps low. By the end of the fourth month the two curves run parallel for two months and then the antigen curve descends strikingly while the antibody curve persists nearly the same in its later course. The same results were obtained in monkeys and cows as in man, and five monkeys thus vaccinated were injected at the fifth month with 0.1 mgm. of living bacilli, and all survived. Four of the five controls died within five months. All these findings harmonize with those obtained by study of the agglutinating and opsonic power after the vaccination. The findings were likewise positive in infants born from women that had been vaccinated in this way during pregnancy. Similar response to the tests were obtained by Levi at Parma; he determined the presence of antigens and antibodies in the blood of mother and fetus, in the placenta and in the milk.

The vaccination was applied to 3702 members of families with tuberculosis between 1907 and 1914. The later history of 1893 is known to date, 1915; of this number 1819 were living and 63 had died from other than tuberculous processes and only 11 had died from tuberculosis. All those vaccinated in 1907 were found to be in good health to date. Of 26 among the earliest vaccinated recently reëxamined by a naval medical officer, all were in robust health, while the complement deviation test revealed persistence of immune principles with predominance of antibodies. A number of persons have been vaccinated elsewhere and in other countries but Maragliano does not include these in his statistics. No inconveniences from the vaccination were ever observed, but the question whether the persons vaccinated might have escaped tuberculosis without this extraneous aid can be answered only by application of the method on a larger scale. At present, man can defend himself against tuberculosis only by acquiring a specific resistance against the bacillus which, notwithstanding all the measures of social prophylaxis, is bound to get to him. In this, Maragliano's research, that is, Italy, has led the way.—*Vaccinazione ed immunita antitubercolare—Studi vari sulla tubercolosi — Terapia specifica, E. Maragliano, Rif. Med., July 5, 1919, xxxv, No. 27, 542.*

Sun Treatment.—A new method of applying heliotherapy by means of a lens was called to the attention of Lovett in the spring of 1919, and he reports the results in a series of carefully observed cases of chronic suppuration in a children's hospital. It had been used by a Mrs. E. C. Post in her sanatorium at Porsmeur, in Brittany, it having first been suggested to her by M. de Thézac. The essential of the treatment is the concentration of the sun's rays by means of a double convex lens, diameter, 12 inches, and focal length, 6 feet. At the focal point, of course, the heat is too great, and in general the patient should be placed at a point where the sun's rays form a circle from 3 to 5 inches in diameter. As the patient is moved away from the lens, of course, the heat increases, and the nearer he is to it it decreases. Moving it thus back and forth is the method of regulating treatment. The lens is mounted a few inches from the end in a canvas cylinder, 1 foot in diameter and 3 feet long. The advantage of the cylinder is that it enables the lens to be pointed directly at the patient and makes the application more definite. The cylinder is on a tripod and can be turned in any direction. The duration of treatment must lengthen progressively, at first, five minutes, increasing five minutes each day until a limit of thirty minutes is reached. In one case a longer period, up to one and one-half hours, was used without harm. The skin around the wound is, as a rule, protected by towels, and the operator wears colored glasses. One treatment a day was given. The effect of the treatment on suppurating wounds was perfectly definite: (1) The discharge immediately increased and then diminished; (2) the granulation took on a healthier color if the patient was anemic, and (3) sensitiveness diminished. In order to test the efficacy of this treatment, a series of suppurating wounds of the severest type was selected, and cases that were obviously difficult. In the wards in a hospital for acute cases it was necessary to select a more acute type than would have been the case in an institution for chronic diseases, as patients that were doing well were discharged to the convalescent home on account of the need of beds, and chiefly the chronic suppurations that were resistant remained long enough to be observed under this treatment. A dozen cases are reported, all observed by members of the staff. Greater progress was made with this method than in those

cases treated by other means. In two acute osteomyelitis cases, in which it was used within a week after operation, it seemed too stimulating. Bacterial count was made in all cases at short intervals, and showed that it was lowered immediately in the discharge. The method seems free from risk when used as directed, and its value seems demonstrated in chronic suppuration from tuberculosis, syphilis and chronic osteomyelitis. The article is illustrated.—*The Thézac-Porsmeur Method of Sun Treatment, R. W. Lovett, J. Am. M. Ass., April 3, 1920, lxxiv, 944.*

Heliotherapy in Mediastinal Adenitis.—About forty to fifty per cent of cases of mediastinal adenopathy are practically cured by direct sunlight treatment, and among the remainder are few instances of complete failure of the treatment. Personal experience has convinced the author, however, that the procedure is by no means equally indicated in all cases. The best results are obtained in pure, uncomplicated adenopathy. In these, all physical and functional signs disappear after four to six months' treatment, and the results are confirmed by X-ray examination. On the other hand, in adenopathy associated with signs of tuberculous impregnation, discrete pulmonary lesions, or the simple bronchial or pulmonary reactions described by Hutinel, results can only be obtained much more slowly. The exposures to sunlight must be of shorter duration. One year should be considered the minimum period required for the treatment, and even at the end of this time there are likely to persist functional manifestations such as temperature instability, or an abnormal bronchial sensitiveness. Finally, a few of these patients are quite intolerant of heliotherapy. Results also vary according to the age of the patient. The older the child, the more readily a cure is obtained. Mediastinal adenopathy in infants is peculiarly severe and likely to spread, and infants are also very sensitive to sunlight, not infrequently showing a rise in temperature to 39° or 40°C. These patients should be allowed to move about during the sunlight exposures, which should not exceed two to two and a half hours a day, even after gradual training. Few children whose lungs have been definitely invaded by the tubercle bacillus derive benefit from heliotherapy; most of them are made worse. —*Traitement de l'adénopathie médiastine par l'héliothérapie, M. A. Dufourt, Presse Méd., August 25, 1919, No. 47, 470.*

Heliotherapy in the Prevention of Pulmonary Tuberculosis after Pleurisy.—The author calls attention to the marked value of sunlight treatment in preventing reinoculation of the system after a spontaneously curable attack of serofibrinous pleurisy. Heliotherapy is dangerous when once the lung has become involved, but if used earlier is of great prophylactic service. Having obtained good results from sunlight treatment in tuberculosis of other serous membranes, especially in peritonitis, sunlight baths were administered to adults or children convalescent from pleurisy. Several of these cases being now of six or seven years' standing, the author feels certain that the measure was of marked assistance in preventing secondary tuberculous manifestations both in the lungs and elsewhere. In applying the treatment to pleurisy convalescents, the whole body should be exposed to sunlight under careful medical supervision. The treatment should be kept up for several years, either continuously or intermittently. If a thorough "cure" is taken at the beginning, and subsequently a few months more of treatment undergone each year at some Southern or mountain resort—or even in urban districts where there is plenty of sunlight during the summer season—a patient who has had serofibrinous pleurisy may practically return to normal life during the intervals between "cures" without having to fear a later outbreak of lung tuberculosis.—*Héliothérapie préventive de l'éclosion de la tuberculose pulmonaire après les pleurésies sero-fibrineuses, I. M. Armand-Delille, Bull. d. l'Acad. d. Méd., October 7, 1919, lxxxii, No. 30, 156.*

Radium and Mesothorium in Vaginal Tuberculosis.—Radium and mesothorium destroy the lesion and the fibrinous change of the local tissues, and even after three years no reinfection has been observed to occur. The destruction of the superficial tissues occurs in the lesions as well as in the normal tissues. They are necrosed and slough off, while in the deeper tissues the degeneration of the connective tissues takes place until cells assume the embryonic state, from which reformation of the new tissues takes place. The author has been unable to demonstrate microscopically the action of these rays against the bacilli. It seems highly possible, however, that the infecting bacilli are so enveloped by the connective tissues that they are unable to maintain life. Amelioration of the general symptoms, restoration of the normal temperature, gain in body weight and appetite, increase of hemoglobin, go hand in hand with the local improvement.—*Action of Radium and Mesothorium on Vaginal Tuberculous Lesions, M. Shiraki, Japan Med. World, September 21, 1919, No. 301.*

Radiotherapy in Surgical Tuberculosis of Children.—Radiotherapy, in the perfected technic of the present day, is the treatment of election in surgical tuberculosis, more especially in the larger cities where the benefits of fresh air, sunshine, and proper food are often not available. The rapidity of resolution of glandular masses is in direct relation to the dose of the rays. Cold abscesses, the pus of caseous suppurating adenitis, should be evacuated by simple incision followed by intensive radiation. The dose and length of session of the X-ray treatment can be adapted to the intensity of the bacillary infection; high virulence calling for large doses, low virulence for small doses. It is possible to give daily treatments for fifteen days without producing a dermatitis, providing the rays are filtered and of short wave length. There is no advantage in intensive radiation of cutaneous tuberculosis in the stage of reparation as this destroys the new cells which form the cicatricial tissue. It is advisable to employ, in conjunction, general hygiene, ample nourishment, heliotherapy, fresh air, and the proper climate to defend the system against the tubercle bacillus, and to prevent the formation of new foci. Surgery, in most cases of surgical tuberculosis in children, should be looked upon as a method of secondary importance. Scientifically practised rontgenotherapy either alone or associated with other phases of treatment is quite capable of curing the so called surgical affections.—*Radioterapia en las tuberculoses quirurgicas de la infancia, R. Espinola, Semana Med., October 30, 1919, xxvi, No. 44, 533.*

Radium in the Treatment of Tuberculous Adenitis.—During 1913–14 between twenty and thirty cases of tuberculous glands in all stages were treated with radium. In every case the swellings of even old sinuses disappeared; unless sinuses were present, no scars were left; no ulceration resulted. The skin in some cases was a little red for a few weeks but this always disappeared. The treatment was as follows: Fifteen milligrams of radium bromide is spread out on a flat circular applicator 1½ inches in diameter, and mixed with a special varnish to keep it even; the applicator has a silver screen 1 mm. thick, and a piece of thin guttapercha tied over the whole. The applicator is strapped on over the tuberculous glands, ten hours being a suitable length of time for each application, that is 150 mgm. hours. It may be put on when the patient goes to bed and taken off in the morning. Two applications a week are usually given; a different set of glands can be treated each time until all are covered, and the course then started again. The treatment is continued until there are no further signs of trouble. Carious teeth and diseased adenoids and tonsils must be dealt with at the start. In very bad cases a few additional applications may be given three months later, but it is doubtful whether this is necessary if the first treatment is thorough. Recently the author has inspected many of the cases treated in 1913–14, and found no trace of any recurrence, nor has any recurrence been reported from the patients not inspected. Three cases are reported in detail.—*Radium in the Treatment of Tuberculous Adenitis, E. S. Molyneaux, Brit. M. J., November 29, 1919, No. 3074, 705.*

Hypertonic Salt Solution in Tuberculous Abscess.—Over 500 tuberculous abscesses in 245 soldiers, mostly prisoners returned from Austria, have been treated by the injection of sterilized hypertonic salt solution composed of magnesium chloride 2.5 grams, distilled water 100 cc., liquor formaldehyde, 0.5 cc. Magnesium chloride is used because of its stimulating action in the process of reconstruction of tissues, as demonstrated by Rosenblith and Delbet. The methods and indications for treatment are the same as in treatment with iodin solutions, but the abscess cavity should be emptied, washed out, and filled with salt solution every four days. This frequency of treatment is necessary because the quantity of lymph collected in the abscess cavity is so great as to produce a slight distention of the tissues and pain. The quantity of liquid left in the cavity varies from 10 to 40 cc. according to the capacity of the cavity and the degree of vascular action. This treatment reduced the healing period to a few months, which under treatment with iodin injections would normally extend over a year.—*Hypertonic Salt Solution in the Treatment of Tuberculous Abscess, L. Durante, Lancet, October 25, 1919, No. 5017, 735.*

Treatment of Tuberculous Abscess by Aspiration.—Several cases of tuberculous abscess are reported which were treated by aspiration. The general treatment was carried on under sanatorium conditions on conservative lines. For the aspiration, a stout needle with good bore was used; an oblique puncture was made, and inflamed areas avoided. Simple aspiration without injection of modifying fluid is often effective, and is to be preferred where the abscess formation can be arrested by this method. A great many diluents have been advocated,

and if they are to be used, the choice will depend largely upon the nature of the case and the personal experience and judgment of the surgeon. Solutions of ether, camphor and thymol have been found effective. Sinus formation is rare following aspiration, while it frequently follows incision. With early diagnosis and efficient continued aspiration, tuberculous abscesses are arrested sooner than by incision, and complications are prevented. In pulmonary cases, avoiding anesthesia gives an additional advantage.—*Treatment of Tuberculous Abscess by Aspiration, Z. P. Fernandez, Lancet, December 27, 1919, 1193.*

Treatment of Lupus Vulgaris.—A first essential of the successful treatment of lupus is the proper selection of cases. A quiescent isolated patch producing neither discomfort nor serious disfigurement does not call for treatment. A lupus patch in active evolution should have sedative treatment only, such as an application of lead and spirit lotion, or a varnish of ichthyol and water, or starch and boric poultices, frequently changed. Each case should be dealt with on its merits; many methods of treatment are available. Excision is the best procedure where there is an isolated patch, not too extensive, and so situated that excision will not cause undue disfigurement. Local application of caustic agents gives excellent results in some cases. The author prefers pyrogallic acid applied in a 5 to 10 per cent ointment. Applications should be renewed until pain becomes severe, then alternated with starch and boric acid poultices. Curetting a lupus patch frequently yields good results, but linear scarification is preferable, followed by the application of a simple ointment; the process of scarification should be repeated about every fourteen days. Freezing with solid carbon dioxide snow yields good results in lupus if the lesion is on the cheeks, when it is single and not too extensive, and when it is hypertrophic rather than atrophic. It should be used with caution in elderly people and in poorly nourished slum children. On account of the danger of epithelioma, the X-ray should be used with caution in lupus. The author prefers a third of a pastille dose through felt fortnightly, rarely carried further than two full pastille doses in all. The ultraviolet ray treatment, using the Kromayer lamp, is preferable, and as a rule gives excellent results, even in cases that have proved resistant to other methods. A diffuse radiation is best; children may be given seven and a half minutes exposures and adults ten minutes. The author has also used an electric lamp with electrodes of pure tungsten, the flame of which is rich in ultraviolet rays. For the destruction of scattered nodules of lupus, ionization with zinc salts is most efficient. Zinc chloride solution (2 per cent) or zinc sulphate (10 per cent) is used, and a current of two to three milliamperes per square centimeter of area. This method is also useful for lupus affecting the mucous membrane of the nose, but here a 2 per cent solution of zinc sulphate should be employed. The method par excellence for the treatment of lupus affecting the mucous membrane of nose or mouth is the electro-cautery heated to a dull red. The results with tuberculin in lupus are disappointing. The author has not tried salvarsan but from his observation of cases treated he believes that such benefit as results is only transient.—*The Treatment of Lupus Vulgaris, R. W. McKenna, Lancet, November 22, 1919, No. 5021, 917.*

Picric Brass in the Treatment of Lupus.—The use of brass paste and brass oil for the treatment of lupus and cutaneous tuberculosis generally results in an immediate improvement. But this healing process gradually slows down as the contact nodules are removed, the remaining deposits being more or less protected bv the healthy surrounding tissue. Hence a number of experiments have been made to find an agent with a still greater power of destruction for tuberculous tissue that would not seriously injure healthy tissues. Attempts were made to secure this effect by varying the proportions of zinc and copper in the picric brass, but without results. Then a number of experiments were made with the nitro-phenyl series, and finally with the sulpho-phenyl series. Ultimately a saturated solution of picric in sulphanilic acid was found to fulfill the conditions. This preparation to which the name of sulphanilic-picric is given, is of a brown color and is fluid at ordinary temperatures. Its power to attack tuberculous tissue is evident on application, and in addition it increases the effectiveness of the picric-brass preparations, so that the two are used together. The results of observations for 12 months indicate that the combination of sulphanilic-picric and brass paste can penetrate and produce complete local destruction of tuberculous tissue without constitutional danger. The usual method of treatment of a case of lupus is to apply a few bro fomentations at two or three day intervals, then to apply the sulphanilic-picric to a small selected area, following a local anesthetic. About five to ten minutes is allowed

for the picric to penetrate. The area is then dressed with brass paste and strapped, or where a lesser action is desired, smeared over with picric brass and left exposed, or by the application of a bro foment, a mere painting with bro. In this way four degrees of destruction are available. Applications are made two or three times a week according to the case, with occasional rest periods. The sulphanilic-picric picks out the tuberculous tissue, staining it yellow. Healthy tissue is only very slightly affected. This preparation may be applied safely to the nasal and buccal mucous membrane, followed by an application of bro. It may also be used, but with caution in tuberculous invasion of the deeper sinuses of the neck.—*Picric Brass Preparations in the Treatment of Lupus, H. A. Ellis, Lancet, November 8, 1919, No. 5019, 827.*

Treatment of Tuberculous Cripples at Leasowe.—The hospital at Leasowe, completed in 1916 is within 300 yards of the sea, and fully exposed to the winds. It is built on the block-pavilion principle, each block consisting of two stories with twenty-four to thirty beds on each floor. The wards face due south, and are not heated. The Leasowe hospital is associated with the Liverpool Health Committee through the Liverpool Child's Welfare Association, and most of the patients are sent by this Association, priority being given to cases of early disease. Other health authorities have beds allotted to them, so that the hospital reaches a wide field. All cases of tuberculosis in children other than pulmonary are admitted, the majority being those with bone, articular or gland foci. Before being admitted to the ward the children are kept under observation for three weeks in single bed cubicles; this secures gradual acclimatization by using the folding doors, reduces the risk of introducing infection, and provides opportunity for investigating possible superadded pulmonary infection. In the wards the majority of the children become accustomed to the open air life and show marked improvement in appearance, weight and appetite. Nervous, excitable and febrile types require extra warmth in winter, and for these a special warm ward is provided. Exposure to the sun is practised whenever possible. The results are most marked in cases of tuberculous glands. Local treatment is carried out on conservative lines with the aim of preserving and restoring the diseased parts. Three hours and a half a day are devoted to school instruction. Eighty per cent of the cases admitted are discharged under the heading of "disease arrested," but the degree of cure naturally varies with the type of case. In the bony and articular types, treatment is prolonged in order that the disability may be overcome; in severe cases corrective operations are performed. The type of case admitted has improved since the opening of the hospital, with the result that average duration of the stay has been shortened and the degree of cure has risen.—*Treatment of the Tuberculous Cripple at the Hospital for Children, Leasowe, T. H. Martin, Brit. M. J., November 22, 1919, No. 3073, 664.*

Tuberculosis of Spine.—A new frame for tuberculosis of the spine is described and illustrated by G. N. Morrill. The disadvantages of the Whitman modification of the Bradford apparatus are: (1) the impossibility of holding the kyphos up, owing to the inevitable sagging of the canvas; (2) difficulty in ascertaining the position of the kyphos after the child is strapped into place, because of the thick padding underneath; (3) the necessarily tight apron holding the patient in position, with the result that not only is breathing made difficult, but the body is flattened and compressed to such a degree that normal development is impossible; (4) bad ventilation caused by direct bodily contact with the canvas cover and rubber sheeting; (5) the fact that the entire frame must be bent to the corrective angle, and (6) the great danger of genu recurvatum owing to the rigid fixation of the knees in a hyperextended position. The description calls for the seven illustrations which accompany the article to make it more readily understandable. The author claims it to be the most practicable device; he has employed it at the Lakeside and Rainbow hospitals in Cleveland in all his acute cases of dorsal and lumbar tuberculous spine.—*A New Frame for Tuberculosis of the Spine, G. N. Morrill, J. Am. M. Ass., January 10, 1920, lxxiv, No. 2, 99.*

Thoracoplastic in Pulmonary Tuberculosis.—Bull has done a thoracoplastic operation in 37 cases of pulmonary tuberculosis and tabulates the details and outcome in all. The mortality was 30 per cent in his earliest 11 cases but since then only 4 per cent and he ascribes this improvement to his practice of doing the operation at two sittings, with an interval of three or four weeks between them. Of the 33 who survived the operation, 7 died later from the progress of the tuberculosis, one surviving for four years; one succumbed to influenza, but 25 are still living, and 11 of these can be regarded as cured, with full earning

capacity; 7 still show symptoms, and in 7 the interval since the operation is too short for determination of the outcome, but most of them regard themselves as cured. A very favorable outcome was thus realized in over 33 per cent of 30 patients, including a number with an interval since of almost five years. When there is a cavity, he aids in the "collapse therapy" by implanting a piece of adipose tissue, cut to fit, from the abdominal wall. In the cases which showed little if any improvement, the operation was incomplete or the general health so poor that the thoracoplastic should not have been attempted. One died from intercurrent disease and in 7 the other lung became affected. Influenza also coöperated in rendering the outlook less favorable than might otherwise have been the case. The danger of the other lung's becoming diseased is the Damocles sword to fear. It is possible that adhesions may be responsible for the failures in certain cases; this is a question requiring further study. The thoracoplastic does not interfere with the use of the arm, nor disfigure, especially when fat implants were used.—*Videre erfaringer om behandlingen av lunge tuberkulose med extrapleural thorakoplastik, P. Bull, Norsk Mag. f. Laegevidensk, November, 1919, lxxx, No. 11, 1105.*

Operative Treatment of Advanced Pulmonary Tuberculosis.—Therapeutic pneumothorax is generally recognized as a valuable aid in the treatment of pulmonary tuberculosis, but in cases where adhesions have united the pulmonary to the costal pleura, no place can be found where the nitrogen or air can be successfully introduced. In such cases Friedrich and Brauer of Marburg University proposed the resection of the tenth to the second or first ribs followed by artificial mechanical compression of the thorax, to collapse the chest wall and produce the same result in such cases as pneumothorax in the more favorable cases. Sauerbruch modified the Brauer-Friedrich operation by doing it in two stages and under local novocaine anesthesia. The author has done extrathoracic thoracoplasty in advanced bronchietatics seven times in the last ten years, but has only recently had opportunity to operate on suitable patients with advanced pulmonary tuberculosis. One patient, a male aged twenty-six had suffered from tuberculosis of the left lung for seven years, and had been under treatment at various sanatoria. The rib resection operation was done in two stages following Sauerbruch's technic, the tenth to the sixth ribs being resected on November 18, 1918, the fifth to the second on December 5. The patient returned to Saranac, and at the last report had gained in weight and strength and "felt fine." Another case is mentioned in which the patient developed a high and irregular fever on the third day after the first stage of the operation; the second operation was not performed, and the patient died soon after his return to the sanatorium. Post-mortem showed a pronounced disseminated tuberculosis in the left lung. The operation undoubtedly offers hope of great improvement and possible cure to some patients otherwise in a hopeless condition. Immediate results from the operation are seen in proliferation of the connective lung tissue, gradual carnification of the elastic lung tissue and reduction in size of cavities; reduction in cough and sputum, disappearance of bacilli, cessation of fever and night sweats and increase in weight.—*Operative Treatment of Advanced Pulmonary Tuberculosis, W. Meyer, Surg., Gynec. & Obstet., February, 1920, xxx, No. 2, 161.*

Endopleural Operations in Pulmonary Tuberculosis.—Failure to obtain good results with artificial pneumothorax in pulmonary tuberculosis is largely due to adhesions between lung and chest wall. In a certain proportion of cases these adhesions may be divided and complete collapse of the lung effected by the method of thoracoscopy and galvano-cauterization devised by Jacobaeus. The instruments employed are the thoracoscope, which embodies the principles of the cystoscope, being fitted with a small electric light and a prismatic mirror at one end, and a lens at the other; and a galvano-cautery 20 to 30 cm. long. The patient lies on his side; the chest wall is anesthetized, and the thoracoscope with its cannula is introduced. The course and character of the adhesions are studied, and the galvano-cautery passed through its cannula, and guided by the thoracoscope to the adhesion at the desired point. The current is turned on by pressure on a spring in the handle of the cautery, and the necessary degree of heat created; adhesions are often speedily destroyed, but in some instances the operation is not successful. The technique of the operation is not easy, and the generation of smoke is often embarrassing. There is danger of hemorrhage, but this is usually prevented by heating the cautery only to a dull glow. Occasionally it might happen that the adhesion contains a direct continuation of the pulmonary cavity; the danger is not great, and is rendered still more remote if adhesions are cauterized as far from the lung as possible. Cutaneous emphysema

and pleural effusion may follow the operation but soon disappear; a rise of temperature is usual, but lasts only a few days. Fistulae may develop in the track of the cannula but usually close without harm to the patient. Twenty-seven cases treated with artificial pneumothorax have been examined by the thoracoscope; cauterization was indicated in nine; five of these were greatly improved; and two others somewhat improved.—*Endopleural Operations in Pulmonary Tuberculosis, Jacobaeus's Method, W. Holmboe, Tubercle, October, 1919, 1, No. 1, 1.*

Respiratory Exercises.—Forcible breathing exercises as sometimes advised are likely to be harmful rather than beneficial in pulmonary tuberculosis. An increase in oxygen favors the growth of tubercle bacilli, and improvement in the pulmonary circulation may increase the absorption of their proteins. The tuberculous patient should never practice forcible breathing, but should breathe naturally, aiming to prolong the inspiratory phase and shorten the expiratory phase. By this method râles become quieter and cough may be controlled. In connection with these breathing exercises a good posture should be maintained, and static exercises —at rest or in bed—should be practised daily. A good diet is important. The addition of 100 grams of butter daily to the diet is a great aid in improving metabolism. —*Respiratory Gymnastics in Tuberculosis, H. C. Lane, N. York M. J., January 3, 1920, cxi, 21.*

Sugar Treatment of Tuberculosis.—Six cases of tuberculosis were treated with hypodermic injections of saccharose, 5 grams in 5 cc. sterile distilled water. Injections may be given daily or every other day. The treatment is entirely harmless and may be used as a routine measure in any institution treating tuberculous patients. In the cases reported the treatment had very little, if any, effect upon the progress of the fever; night sweats and expectoration ceased almost immediately The reduction of the cough was not in proportion to the reduction of the expectoration, and a dry and distressing cough might be present at first, but was more or less controlled later. There was a marked gain in weight and strength with an amelioration of the toxemia and its depressing effects.—*Sugar Treatment of Tuberculosis, A. Sterling, Med. Rec., December 6, 1919, xcvi, 927.*

Modern Treatment of Tuberculosis.—For some time it has been recognized that the three chief factors in the treatment of tuberculosis are rest, good food and fresh air. To these a fourth element must be added, which is contentment and happiness To attain this the physician himself must be optimistic and able to inspire optimism in others. Patients must be instructed and aided by proper suggestive treatment to overcome their worries and control their emotions. Suitable forms of amusement and diversion should be provided through lectures, moving pictures, theatricals and good reading matter. The institutional air of the sanatorium should be as far as possible dispelled, and the sanatorium made to seem more like a great country estate, the home of a large and happy family. Individual symptoms should be properly treated but their importance should not be overemphasized. Tuberculin is of value only in selected cases and when employed by a physician trained in its use.—*Modern Treatment of Tuberculosis, R. C. Kirkwood, Med. Rec., December 20, 1919, xcvi, 1015.*

"Tubercle:" A New Journal.—A new monthly journal dealing with tuberculosis appeared in October, 1919 under the title, *Tubercle*, published in London. The editorial in the first number states that *Tubercle* will not be the organ of any existing society or group. It will for the present serve the purposes of keeping workers, however isolated, in touch with each other, and with promising fields of investigation and research and will work in friendly coöperation with every agency engaged in fighting tuberculosis. It will include original articles on all phases of tuberculosis, and a summary of current pathological, clinical and sociologic work. Though scientific accuracy is aimed at in all sections of the journal, clear and simple language will be used so that it will appeal not only to medical readers, but to all engaged in the campaign against tuberculosis, including public health committees, health visitors, nurses and social workers.—*Editorial, Tubercle, October, 1919, 1, No. 1, 14.*

Classification in Pulmonary Tuberculosis.—Various systems of classification for pulmonary tuberculosis have been proposed—the best known of which is the Turban-Gerhardt classification of stages 1, 2, and 3 according to the extent of the disease. The city of Edinburgh has employed a classification on this basis similar to that adopted by the sanatorium workers of North America. To this some indication of the general condition of the patient has been added by the author with a threefold division of (a) good; (b) moderate and (c) bad; (a) indicating few con-

stitutional signs, slight cough, bacilli absent or scanty, loss of weight about 6 pounds in as many months; rectal temperature not exceeding 99.2°F., no complications; (b) cough and sputum more pronounced; bacilli present; more than 6 pounds lost in six months; temperature from 99.2°F. to 100.5°F., slight complications; (c) general constitutional disturbance more marked than in b, grave tuberculous complications. By a combination of the symbols, such classifications may be made as stage 1A, 3A, 2B, 1C, etc. In some cases the lung lesion is so quiescent as to produce no constitutional disturbance, or may have been quiescent so long that it can properly be called healed. Then the case may be classified as stage 1 healed, stage 2 quiescent, etc. The great difficulty is in the classification of borderline cases, not far enough advanced to be assigned to class 1A. Cough not accounted for by any other condition, gradual but persistent loss of flesh amounting to 6 pounds in six months for adults, loss of energy, loss of appetite and deterioration of the blood with all other possible causes excluded, justify a diagnosis of tuberculosis, even in the absence of pulmonary signs. Among the working class in the city, such a group of symptoms may be associated with overwork, under-feeding and unhygienic conditions. Here, if cough is not a prominent feature, definite pulmonary changes, or occasional rises of temperature for some days would be necessary to make the diagnosis more than suspect. All cases of hemoptysis and of idiopathic pleural effusion should be classed as tuberculosis. The tuberculous syndrome, coupled with intimate and prolonged exposure to infection, especially in children, is definite evidence of tuberculosis. All such cases without pulmonary signs should be classified as stage A; where the syndrome is not complete, or where other factors confuse the diagnosis the classification should be stage A suspect, or simply suspect.—*The Necessity for a Uniform Standard of Classification in Pulmonary Tuberculosis, J. Guy, Tubercle, October, 1919, 1, No. 1, 9.*

Tuberculosis.—Notwithstanding the advances in later years in regard to tuberculosis and the apparent reduction in its mortality it is evident that the control of tuberculosis is far from what it should be. There is a factor in its persistence that has somehow escaped our notice, and it may well be, that it is the neglect of the social side which is responsible for our failure to bring about better results. The support of this view is found in the acknowledged experience that the onset of the disease is largely dependent on bad habits and manners of living enhancing the individual susceptibility. Probably too much emphasis has been laid on contagion and too little on the predisposing causes. The social factor is also important in determining the opportunity for early treatment, and too little attention is given to the improvement of living conditions and financial needs, important in many cases. Right living will prevent the persistence of tuberculosis. It may be, however, that certain climatic conditions increase the susceptibility in this country. Our severe winters and overheated dwellings and the possible danger in common bathrooms and washing facilities are perhaps overlooked. Craster lays down a city plan for tuberculosis control, including: A, control of infection by universal reporting by physicians, suitable hospitals and sanatoriums, day camps and laboratory facilities, antispitting laws and milk supervision; B, social progress through publicity, social insurance, antituberculosis societies and home visiting and relief; C, economic improvement by improved housing, industrial hygiene, open air schools, vocational training and employment bureaus; and D, associated activities, such as control of epidemics, convalescent houses, child hygiene and mental hygiene. Each of these points is taken up in detail. The reporting by physicians must be imperfect. If the number of reported cases equals one-third of the actual number existing we should have a pretty fair percentage of the notification. Duplicates should be accepted as the physician may have no knowledge of previous reporting. Follow-up questioning, laboratory reports, specialized health nurses and clinics, and hospitalization supported and supervised, at least, by the public to some extent, and instruction of the public to overcome prejudice, etc., are mentioned. Some patients will attend day camps but refuse other kinds of outdoor treatment. Laboratory facilities should be improved and milk supervision should be very strict. As regards social progress and relief there is much work to be done. There is no disease so closely connected with poverty and distress, and there is obvious need for instructed benevolence in these cases. Insanitary conditions and habits, however, are not confined to the poor. The effect of dusty trades may have been overestimated, as the evidence of mechanical injury to the lungs is insufficient. There are, however, occupations that predispose toward the disease, but much progress has been made here. As for the value of associated activities, child hygiene and conva-

lescent homes and mental hygiene, our latest health activity, will all tend to reduce abnormal conditions favoring the spread of disease.—*Tuberculosis: A City Plan, C. V. Craster, J. Am. M. Ass., January 31, 1920, lxxiv, No. 5, 302.*

Tuberculosis. In the hubhub which has been stirred of late over venereal diseases, we are in danger of forgetting that tuberculosis is still with us and in about as great force as ever before. Moreover, instead of this disease being known in detail it seems much more of a mystery than ever. Twenty years ago its origin and the method of stamping it out seemed solved, but not so today. We are not even certain as to how the disease finds entrance to the body, the relationship of the bovine to the human bacillus has not been cleared up, and the cure of the patient is as uncertain as ever. At this time the résumé of a study of the subject made by the Medical Research Committee for National Health Insurance in Great Britain should be of much interest. It is pointed out in the introduction of the report that, in a previous study of the registrar general's returns for tuberculosis, it was discovered that there is not one form of the disease but two, and perhaps three types. One form attacks chiefly those between twenty and twenty-five years, a second kills most commonly between forty-five and fifty, and a third proves fatal between the ages of fifty-five and sixty. The existence of these types must be kept in mind and the prevalence in a community of one or another form, when studying the effects of climate or of occupation.

A study of various districts of the United Kingdom shows that the death rate differs in them, and that it differs at the different age periods. Changes have taken place in the past fifty years in the proportion of deaths from the different types. These changes are especially marked in the northern countries. The chief seats of early phthisis are the seaboard and agricultural counties, there being in the Shetland Island, none but the early form. The death rates for males and females are absolutely distinctive, the death rate curves for females being more uniform and the maximum rate falling in the second period or around the ages from thirty to thirty-five. There is three times as much phthisis of old age among males. Seamen have a high tuberculosis rate and agricultural laborers a low rate. File cutters, tool manufacturers, stone quarrymen, masons, brick layers, and all miners except of iron and coal, show higher death rates than the occupied males at large. Tin miners have an especially high rate, but in all these occupations the type of disease follows the type of the locality and is not influenced by the occupation.

The report concludes that since tuberculosis is not a single disease but a group of diseases, like the typhoid-paratyphoid group, this must be considered in attempts at serum treatment. Tuberculin made from the bacillus of one type would not be expected to influence another type of the disease. The predominant type differs in different regions. The young adult type, like scarlet fever, is not affected by environment. There is as much of this form in healthy as in unhealthy homes. In scarlet fever the amount of disease seems to depend on the amount of milk consumed, and we are left to infer that milk may have to do with this form of tuberculosis.

Viewing the subject historically the report concludes that a long drawn out epidemic of the young adult type of the disease has been going on which reached its climax about fifty years ago, while the middle age type reached a maximum figure a hundred years ago. The rise in the mean age of death from the disease does not seem to be due to an increase of immunity but to a decline of rate of the younger form. The fall of the death rate for both the early and the later types of the disease began so far back, and has been so steady, that there is no doubt that a considerable part of the decline of phthisis in recent years is in line with the biological properties of diseases in general, and has little to do with hygienic conditions.—*Editorial Note, N. York M. J., January 31, 1920, cxi, No. 5, 204.*

Concerning Tuberculosis.—The prevalence of tuberculosis in Europe has increased very considerably as a consequence of the war, of which it is one of the saddest aftermaths. In Great Britain the increase of mortality from the disease is said to reach 12 per cent. In France the increase has been no doubt even greater, and on the Continent generally, as was only to be expected, the incidence of and mortality from tuberculosis have been augmented. Before the war steps had been taken to arrange for the carrying on of a much more vigorous campaign against the malady in America and Great Britain than had been waged formerly, but in the latter country the war had the effect of almost completely stopping these plans. At the British Tuberculosis Congress, held in 1913, it was thought and said that a crusade conducted on certain lines which had been mapped out would result, if not in the extinction of tuberculosis, at least in a most satisfactory

curtailment of its powers for evil. It was thought that knowledge of the disease was such that it only required to be put into practice thoroughly to achieve the end desired. The war, however, appears to have shown that these hopes were premature.

The experience of France demonstrated the fact that a large proportion of its population suffered from latent tuberculosis, which the stress and strain on the nervous system and physical powers brought about by the war rendered active. According to Colonel Rist not fewer than 80,000 men were discharged from the French army because of tuberculosis. It is stated that at the beginning of the war, owing to the urgent need for men, the examinations were hasty, and many tuberculous subjects were passed into the army. The result was inevitably widespread infection to such an extent that the French Government in 1917 accepted the American offer of help through the Rockefeller Institute. The final outcome of the efforts of the American physicians and nurses will not be evident for some time to come, but up to the present time the work has afforded grounds for hope.

It is recognized in Great Britain that while in many respects its tuberculosis specialists have been pioneers in treatment, at the same time they have been too conservative, too narrow in their views, in fact, and afraid to launch out in the same way and to the same degree as the Americans. For example, Prof. William C. White of Pittsburgh, in an address delivered before the conference of the British Association for the Prevention of Tuberculosis, spoke of the work which has been and is being done by the tuberculosis nurse in America. He estimated at 60 per cent the nurse's share of all the work done against tuberculosis in America. Sir Arthur Stanley, chairman of the Joint War Committee of the British Red Cross Society and the Order of St. John, speaking at the same meeting, announced that the Red Cross would find funds for antituberculosis work, and in addition a very large number of women would gladly give their services to the same cause

Dr. Christopher Addison, the Minister of Health, who gave the opening address at the Tuberculosis Conference, laid most insistence on adequate, sanitary and comfortable houses as a means of combating tuberculosis. The sanatorium did not appear to be regarded with so much favor as formerly, although, as one speaker remarked, it was not the fault of the sanatorium, but was due to the fact it was not usually employed properly. The consensus of opinion expressed by the speakers was that in order to fight tuberculosis successfully coördination is required, and to obtain such coördinated effort the masses must be educated in public health matters. It may be noted that at the conference it was acknowledged that American organization for dealing with tuberculosis was the most effective.—*Editorial, Med. Rec., December 20, 1919, xcvi, No. 25, 1020.*

Tuberculosis Problems in the New Age.—The war has brought out the fact that the former conception of the proper means to combat tuberculosis was far too narrow. The fault in public health work has been that it has not penetrated to the mass of the population. In bringing skilled knowledge into practice in the every day life of working class households there is a great opening for a band of trained workers such as the public health nurses in America. No one regards the sanatorium as all-important in antituberculosis work; it is merely a link—a very useful one—in the administrative chain. Dr. Addison has named three factors of paramount importance—housing, an educational campaign, and research. The first and third of these depend for their realization on the expenditure of money, the second is largely a question of personal effort. The lesson of the war will not have been in vain if it leads to a proper appreciation of the value of coordinated action in pursuit of national health, and particularly in the elimination of tuberculosis.—*Tuberculosis Problems in the New Age, Editorial, Lancet, October 25, 1919, No. 5017, 743.*

American Red Cross Tuberculosis Commissions.—The achievement of the American Red Cross Commissions in checking tuberculosis in Italy and France gives evidence of the spirit of friendly criticism and coöperation by which it was made possible. The work of investigation in Italy was carried on in three main fields,—school hygiene, child labor, and housing. The assistance offered by the Italian School Hygiene Association in allowing visiting and close inspection of existing conditions and in giving the American Commission full access to the rules and regulations already in force greatly aided the Red Cross workers in making a thorough and an intelligent study of the situation. It is plain that Italy needs to introduce and enforce some means of teaching her people even the most elementary rules of hygiene; suggestions for improving the present system have been made by the American Commission and have met with the approval of

the Italian health authorities. The report of the Commission states that already measures have been adopted for emphasizing the prevention rather than the cure of tuberculosis; legislation has been formulated which aims to protect infant welfare, maintain during school life a regard for hygienic conditions, and directs the employment of young boys and girls so that they may not be forced to accept work which will be detrimental to their future health.

In France, also, a Commission investigated the local conditions, and, by the aid of grants of money, organized a chain of health centers for the provision of special treatment. Here, too, the importance of training school children to observe the fundamental principles was emphasized, and carried out by the coöperation of children, parents, and teachers. Lists were made of hygienic rules to be followed, such as personal cleanliness, plenty of fresh air at night, and daily exercise—a series of tasks in which the children manifested a real pride in performing faithfully. Perhaps one of the most far-reaching results of the work of the Commission in France was the establishment of a system whereby local practitioners are to carry out the work which has been outlined in some parts of the country by their American colleagues.

That the criticism and suggestions offered by the American Commission to health authorities in Italy and France have been received gratefully by these countries and have been made in some instances the basis of future reform, indicates the value of international coöperation in matters pertaining to the investigation and prevention of disease. It is to be hoped that the efforts of the American Red Cross Tuberculosis Commissions may prove to be only the promise of success in carrying out even more extensive activities which we may anticipate for the future.—*Editorial, Boston M. & S. J., October 30, 1919, clxxxi, 545.*

The Prevention and Arrest of Tuberculosis in Canada.—Dr. George Porter, secretary of the Canadian Association for the Prevention of Tuberculosis, contributed some interesting data regarding the control of tuberculosis in Canada. Apart from an annual subsidy to this association and quarantine at ocean ports, the federal government has not taken any part in the control of this disease, leaving all such matters of public health to the nine provinces. Recently, however, on account of returned tuberculous soldiers, the government has taken over the care of these; and now that Canada has a well organized Department of Public Health, a nation-wide campaign may be expected against this disease. Twenty years ago there was but 1 small institution of this character in Canada. Ten years afterward 6 were established. At the present time there are 40 sanatoria in addition to those set apart for soldiers. Only 30 patients could be accommodated twenty years ago. In ten years there were 350 beds. Now Canada has 3500 beds. More than $1,000,000 are spent annually in the maintenance of civilian institutions; and the total value of these institutions is more than $3,000,000. The National Sanatorium was the pioneer organization, which began work in 1906. This association has now accommodation for 800 patients in Muskoka and Weston, near Toronto. The province of Nova Scotia was the first to establish a provincial sanatorium, and the city of Hamilton, Ontario, was the first to establish a county or municipal institution of this character. The province of Ontario, while not conducting an institution of its own, allows one-fifth of the original cost of the building up to $5000 and $3.50 a week for each patient for maintenance, and the municipality from $4.90 to $7.00 per week. Some provinces allow more, some less, while two of them have done practically nothing. The incidence of tuberculosis in the Canadian Army is less than that in the civilian male population of military age. The number of returned tuberculous soldiers up to July 1, 1918, was about 4000, with at that time about 1500 abroad to be returned to Canada which at the present time has been accomplished. As there were 50,869 Canadians killed in action or dying from wounds, Canada has had nearly as many civilian deaths from tuberculosis during the war period as fatalities among Canadian soldiers.—*Editorial Note, N. York M. J., February 28, 1920, cxi, 379.*

The Tuberculosis Death Rate.—The report of the executive committee of the National Tuberculosis Association points out that the annual number of deaths from tuberculosis is 150,000. This means that this disease annually sacrifices more lives than America lost in the war. The examinations under the draft law resulted in the rejection of 100,000 young men because of tuberculosis, many of whom had no suspicion that they had the disease. There are over one million known cases of tuberculosis in the United States, and the result of the draft examinations would indicate that there are double that number of unsuspected cases. If taken in time, there is no serious disease quite so amenable to treatment as tuberculosis. Hence it is impor-

tant that patients should be willing to submit to proper treatment in the earliest stages, and that physicians should be able and willing to diagnose the disease from the early symptoms. A persistently rapid pulse should be regarded with suspicion; if, with this there is loss of weight and a history of contact with tuberculous patients, it is almost sufficient to justify the diagnosis of tuberculosis. If there is a slight hacking cough, though without expectoration, the suspicion is amply confirmed; while any local lung symptom, such as a lengthening of expiration at one of the apices, gives proof positive of a tuberculous infection of the lungs. If when those symptoms are present the patient can be made to gain weight, and to alter his mode of life so as to spend more time in the open air there is an excellent chance of making the case one in which the presence of tuberculosis will be absolutely demonstrated only after death. Waiting until there is a definite febrile reaction, or until tubercle bacilli are found in the sputum, very often means a long road to recovery, and serious impairment of vitality. When these facts are explained to a patient with the incipient symptoms, it will encourage rather than discourage him, and make him anxious to persist in the treatment that will prevent more serious developments.—*The Tuberculosis Death Rate, Editorial, N. York, M. J., October 11, 1919, cx, No. 15, 621.*

International Standards of Public Health Work.—In order to fix a basis for international public health work, we must first determine the essentials and their relative value in relation to the budget available; secondly we must establish the working units; and finally these units must be correlated into a complete whole. Tuberculosis has always had a prominent place in the formulation of public health programs, because we have no specific cure for the disease, and must rely upon organization and coördinated effort for its control. In the past too much emphasis has been laid upon details and special measures for the control of tuberculosis. What is necessary is the modification of equipment to meet the needs of each locality, and to determine this a careful statistical study of every district must be made, and the available funds ascertained. Because approximately 85 per cent of tuberculosis cases must be cared for in the home, the importance of the public health nurse is great. The nurse and the amount of territory and the number of people whom she can adequately handle should constitute the working unit. To these units, other necessary equipment can be added—dispensaries, laboratories, hospitals for advanced cases, sanatoriums, etc. Coöperation should also be established with organizations dealing with related problems—child welfare, housing, etc. The function of the national government is to study, correlate, suggest, stimulate and subsidize the work of the local units so that standards may be uniform. And uniform standards must also be set up throughout the world by the united effort of Great Britain, America, France and Italy.—*International Standards of Public Health Work, W. C. White, Lancet, October 25, 1919, No. 5017, 719.*

Tuberculosis Experience of Metropolitan Life.—Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Company, draws the following conclusions from a study of the mortality experience from tuberculosis in the Industrial Department of the company in 1918: (1) The death-rate from tuberculosis (all forms) in 1918 continued to decline, the rate being 187.4 as compared with 188.9 in 1917. There has been a decrease in the annual death-rate, without exception, since 1911, when the rate was 224.6 per 100,000. (2) The reductions in the rate since 1916 have been much smaller than in the preceding years; 1.3 per 100,000 in 1917 and 1.5 per 100,000 in 1918 as compared with 11.7 per 100,000 in 1912. (3) Since 1911, the total reduction in the tuberculosis death-rate has been 37.2 per 100,000, or 16.5 per cent of the 1911 rate. One death in every six from tuberculosis has been either prevented entirely or delayed. This is equivalent to the saving of more than one-third of a life from tuberculosis alone among each 1000 persons insured in the Industrial Department. (4) The conditions with reference to tuberculosis of the lungs are identical with those for tuberculosis (all forms) described above. (5) The improvement in 1918 as compared with 1917 would have been much greater but for the last three months of the year. In the first nine months, the 1918 rate was seven per 100,000 lower than the 1917 rate; but, for the last three months, the rate was 16.8 per 100,000 higher than the 1917 rate. The tuberculosis death-rate usually drops considerably in the last quarter of the year; but, in 1918, probably because of the influenza epidemic there was next to no decline. (6) Exactly similar conditions are found in the population figures for both the State and City of New York. The 1918 tuberculosis figures were either identical or somewhat lower than those for 1917. In the last quarter of the year, the rate was somewhat higher in

1918 than in 1917. In the first nine months, the 1918 rate was considerably better than the 1917 rate. This is an important point because there had been some fear that war conditions would result in an increase in the death-rate from tuberculosis. Apparently this has not occurred in the population of New York City or of New York State, or among the Industrial policy-holders of the Metropolitan. (7) Considered by *age period*, the figures show that the death-rate for tuberculosis of the lungs at ages under 15 remained stationary in 1918 as compared with 1917; went up for the period 15 to 24; declined from age 25 up to 55 and remained stationary from 55 to 65. (8) The white females *alone* show increases in the rate at the ages of adult life. The white males, colored males and colored females all show reductions between 25 and 55. (9) All the four groups, i.e., white males, white females, colored males and colored females, show increases in the rate at the age period 15 to 24 years. This is very clear, but the reason for the increase is difficult to understand. The number of deaths from tuberculosis (all forms) in 1918 was 21,827. If the same rate as in 1911 had prevailed, the number of deaths would have been 26,130.—*Leaflet, distributed by Metropolitan Life Insurance Co., Industrial Tuberculosis Experience in 1918.*

Tuberculosis in New York City. Quarters Ending December 31, 1918 and 1919.

		MANHATTAN	BRONX	BROOKLYN	QUEENS	RICHMOND	CITY
Population	1918	2,731,731	622,555	2,023,170	392,966	101,721	5,872,143
	1919	2,780,485	645,894	2,070,539	406,236	103,640	6,006,794
New cases	1918	1,188	317	588	117	23	2,233
	1919	2,103	508	907	239	37	3,794
Total cases in register	1918	18,903	3,447	7,792	1,654	252	32,048
	1919	17,449	3,583	7,212	1,525	267	30,036
New patients examined at clinic	1918	1,682	552	1,717	130	10	4,091
	1919	1,981	442	1,230	156	25	3,834
Cases under supervision	1918	1,708	1,997	5,579	54	11	9,349
	1919	130	143	368	8	5	654
Voluntary renovations	1918	537	87	585	78	3	1,290
	1919	386	73	221	97	42	819
Sputum examined	1918	5,832	1,541	2,242	419	85	10,119
	1919	5,790	1,588	2,766	484	98	10,726
Positive sputums	1918	1,251	297	605	100	21	2,274
	1919	1,133	314	515	102	14	2,078
Deaths	1918	1,041	238	683	151	59	2,172
	1919	693	161	453	83	28	1,418
Death rate per 1,000 of population	1918	1.51	1.52	1.34	1.53	2.30	1.47
	1919	0.99	0.99	0.87	0.81	1.07	0.94
Deaths all forms Tuberculosis	1918	1,176	265	763	165	64	2,433
	1919	794	183	518	93	32	1,620
Death rate, all forms	1918	1.71	1.69	1.50	1.67	2.50	1.64
	1919	1.13	1.12	0.99	0.91	1.23	1.07

—*Weekly Bull. Dpt. Health, N. Y. City, March 27, 1920, ix*, 101.

Tuberculosis Statistics for 1918.—Tuberculosis in its various forms caused 122,040 deaths, of which 108,365 were due to tuberculosis of the lungs. The death rate from all forms of tuberculosis was 149.1 per 100,000 and from tuberculosis of the lungs, 132.4. The rate from tuberculosis of all forms declined continuously from 200.7 per 100,000 in 1904 to 141.6 in 1916, the decrease amounting to nearly 30

per cent; but for 1917 and 1918 increases are shown, the 1918 rate being somewhat higher than the rate for 1917, when it was 146.4. Until 1912 more deaths were due to tuberculosis than to any other single cause, but in that year and during the period 1914-1918 the mortality from tuberculosis was less than that from heart diseases.—*Principal Causes of Death in United States Registration Area, Publ. Health Rep., February 13, 1920, xxxv, No. 7, 34.*

Conjugal Tuberculosis.—Students of tuberculosis have repeatedly called attention to the relative infrequency of conjugal infection in tuberculosis. In the case of tuberculosis, numerous investigators have noted that phthisis in both husband and wife is very rare, despite the fact that they probably come into more intimate contact than even father and child.

Following a summary of conjugal tuberculosis, Fishberg in the latest edition of his work *Pulmonary Tuberculosis* comes to the following conclusions: (1) Tuberculous infection can only occur once; and (2) phthisis evolves only in persons who are for one reason or another predisposed to the disease. Inasmuch as the nonphthisical consort has already been infected with tubercle bacilli during childhood, all new opportunities for reinfection by cohabitation with a consumptive consort are of no avail to produce phthisis. It is his or her constitution that determines whether consumption will develop and not the opportunities for reinfection.

The correctness of the view expressed above has recently been challenged. In an interesting article entitled "Conjugal Tuberculosis," published in the *Lancet* (October 4, 1919), E. Ward, M.D. tuberculosis officer for South Devon, gives the results of an inquiry extending over a period of five years, and relating to 156 cases in which the mate of a tuberculous husband or wife was examined. The results of these examinations are tabulated as follows:

Chart I. Results of examination of contacts of tuberculous patients, husband and wife

	NUMBER EXAMINED	TUBERCULOUS	SUSPECT	NEGATIVE	PERCENTAGES		
					Tuberculous	Suspect	Negative
Wives (husband first notified)..	120	66	12	42	55	10	35
Husbands (wife first notified)..	36	25	4	7	69	11	20
Total.........	156	91	16	49	58	10	32

"In deciding to which category a contact belongs, the examination was not made so punctiliously that few could escape the net; two or more definite indications were required. Crepitations at one apex alone would not be called tuberculosis, but crepitations at one apex, plus a history of hemoptysis, would be so called. Similarly dulness and crepitations at one apex would be classed as tuberculosis; and also failing health, hemoptysis, and dulness, with crepitations, at one base. If the signs found were suggestive, but not sufficiently conclusive, the contact was classed as suspect. Comparing now the results of examining contacts other than husband and wife; out of 1067 examined, 219 were tuberculous, 284 suspect, and 564 negative; or, roughly, 20 per cent, 27 per cent, and 53 per cent (Chart II). Taking as a further control the contacts of cases seen for an opinion and diagnosed nontuberculous, either at the time of the first visit or later, out of 81 examined, 4 are found to be tuberculous, 7 suspect, and 70 negative; or in percentages, 5 per cent, 8 per cent, and 87 per cent (Chart III). Cases of definite surgical tuberculosis, and their contacts, are included. but the number of such cases was relatively small."

Chart II. Results of examination of contacts of tuberculous patients other than husband or wife

Number examined..........		1,067
Tuberculous..........	219	
Suspect..........	284	
Negative..........	564	
Percentages:		
Tuberculous..........		20
Suspect..........		27
Negative..........		53

Chart III. Results of examination of contacts of nontuberculous patients, including husband or wife

Number examined..........		81
Tuberculous..........	4	
Suspect..........	7	
Negative..........	70	
Percentages:		
Tuberculous..........		5
Suspect..........		8
Negative..........		87

After discussing the results of this investigation, the author concludes as follows: Well knowing the difficulties in the way of any statistical investigation such as this, I make no claim that the present contribution is a final settlement of the question, but am sure that this important subject should be reconsidered in the light of the greatly increased material now available. On the opinion generally held regarding infection the success or failure of all our antituberculosis work depends. Either we take the fatalistic view of a universal infection and family predisposition (I almost wrote predestination), and therefore direct our efforts to help the tuberculous individual, or we look upon the disease as infectious, and take

means to prevent it by isolating highly infective cases, there being as yet no method of universal vaccination against tuberculosis. I estimate that over 50 per cent of all cases seen are due to direct personal infection, and am therefore a strong advocate of preventive measures.

With the large number of well-organized tuberculosis clinics at work in this country, it should not be difficult to obtain a large amount of accurate statistical information to determine which view represents the true condition. Further studies along this line are certainly desirable, for the question at issue involves one of the most fundamental points in the whole tuberculosis campaign.—*Publ. Health Rep., January 30, 1920, xxxv, No. 5, 219.*

Bovine Tuberculosis.—An address by F. W. Harding, secretary of the American Short Horn Breeders' Association, devoted chiefly to discussion of the tuberculosis problem. The beef cattle breeders strongly favor nationalization of the subject and the adoption of the most uniform regulations and methods of dealing with tuberculosis that can possibly be agreed upon between the states and the national government. He pointed out many of the marked differences and glaring inconsistencies in the present varying regulations by different states. He particularly criticises the recommendation that animals be tested within thirty days of the time they are shipped into certain states, stating that it did not give the breeder of pure-bred cattle time to get out his catalogue, hold a sale and dispose of his cattle after a test was made. He also opposed the sixty-day retest, stating that this should be left to the honesty and integrity of the breeders. He strongly urged that show cattle being taken from one state fair to another be not required to comply with the regulations for the shipment of cattle into those states. He dwelt at some length upon the value of the tuberculin test in certain cases, and quoted Dr. Alexander of the University of Wisconsin as having said he did not believe that valuable breeding animals should be condemned for tuberculosis on the result of one test.

He deplored the cost of the tuberculin test as being a hindrance to the trade in pure-bred live stock, stating that many young bulls were sold for improving the quality of beef cattle at a price around $200 and that at the present it cost about $20 to test such a bull before shipping and an additional $20 for the 60-day retest, and that $40 for the testing and only $200 for breeding, rearing, feeding and selling the bull was not fair. He strongly favored the segregation of reacting animals and the retention of those that were good breeders. He spoke favorably of the accredited herd plan, but stated that only a beginning had been made and he did not see how it would be possible to apply it to all the herds in the country, stating that there are 35,000 herds of registered short horn cattle alone, and that it would appear it would take as great many years to get this number of herds on the accredited list. He personally would rather buy cattle from a herd that had passed a successful test within thirty days than to get them from an accredited herd that had not been tested for approximately a year. Harm was being done by giving some animals enormous doses of tuberculin and such doses are unnecessary. He assured the live stock sanitarians and practising veterinarians present of the fullest coöperation of the beef cattle breeders in the continuance of any reasonable measures for the control of tuberculosis.

Senator J. M. Hackney of Minnesota, Secretary of the American Holstein-Friesian Association, made one of the most excellent addresses of the whole meeting. Like Secretary Harding, this discussion was devoted almost exclusively to the tuberculosis problem. He stated that in his locality there were plenty of veterinarians who were well advanced in horse diseases, but that they found it difficult to procure men who had the necessary experience and ability in handling the diseases of cattle, especially the diseases of dairy cattle. He was loudly applauded when he said: "Any man who puts up an animal for sale either at a private sale or at an auction, who knows that that animal is tuberculous should be indicted and convicted as surely and as quickly as though he had committed murder." He told of an interesting experience that he had while a member of the Minnesota Senate. A bill had been introduced in the state legislature to prohibit the tuberculin test. A majority of the members of the legislature seemed to favor it. He obtained permission to test a herd and found 19 reacting animals. These were sent to the St. Paul yards and slaughtered and members of the legislature invited to witness the autopsies. Not all of them attended. He obtained diseased organs of the animals, took them to the State House and put them on display in the corridors where the members could not help but see them. Instead of prohibiting the tuberculin test in Minnesota, the legislature enacted laws strengthening its application.

Senator Hackney's experience with the Bang method or the segregation of affected animals was unsatisfactory. He favored,

however, permitting herds on the accredited list to use a reacting sire and thought that the tuberculosis free accredited plan should be changed to permit this. He made a strong plea for the recognition and use of certified milk and deplored the fact that many practitioners of human medicine did not seem to realize its superiority over a pasteurized product.—*Twenty-third Annual Meeting of the U. S. Live Stock Sanitary Association, Am. J. Vet. Med., March, 1920, xv, No. 3, 105.*

Tuberculosis Eradication in Stock.—A conference on tuberculosis eradication was held at Chicago October 6, 7, and 8, 1919, under the auspices of the United States Bureau of Animal Industry. About forty states were represented by the State Veterinarian or State Live Stock Sanitary Commissioner or both. The discussions revealed a wide difference of conditions and problems, but a rapidly increasing interest among farmers and stockmen in the question of tuberculosis, and a constantly growing demand for scientific tests. The merits of the various tuberculin tests were carefully discussed. The subcutaneous test is most widely used, but the intracutaneous and conjunctival tests also are employed. The intracutaneous test is especially useful in testing range cattle and others unaccustomed to handling; it is also useful in very hot or cold weather, when atmospheric conditions affect the temperature readings on which the diagnosis by the subcutaneous test depends. The eye test is used in combination with other tests or as supplementary in suspicious cases. When used in combination the tests appear to be an almost unfailing means of diagnosing the disease. The accredited herd plan is very generally favored, under which Federal and State authorities grant a certificate to owners of herds found to be free from tuberculosis and maintained in a prescribed manner. The eradication of tuberculosis in cattle will practically solve the question of controlling the disease in swine, as the evidence shows that swine are infected chiefly from cattle, either by following them in feed lots or pastures, by being fed on tuberculous dairy products, or by eating tuberculous carcasses. By means of a practical and simple marker on hogs for slaughter, a shipment can be traced back to the farm whence it came if the meat is found diseased, and the infection can be stamped out at its source. The tendency in tuberculin testing is away from the use of large doses. Many of the delegates believed the use of more than 10 cc. of tuberculin was unwise. Dr. Mohler's opening address dealt with the problems to be discussed, especially the accredited herd plan.—*Tuberculosis Eradication Conference, Editorial, Am. J. Vet. Med., November, 1919, xiv, No. 11, 555.*

Prophylaxis of Bovine Tuberculosis.—To sweep away all indemnities, etc., for tuberculous cattle, and place the loss squarely on the shoulders of the proprietor, is the only effectual way to stamp out bovine tuberculosis. This makes the loss from it so excessive that the proprietors will be forced to take steps to protect their herds against it. According to the present measures, the proprietors have comparatively little personal interest in stamping out the infection. When they find that unless they do this their losses will be excessive, a new order of things will be inaugurated. Three things are necessary for this: (1) The nullification of the sale of any animal found to be tuberculous. The animal to be returned immediately to the vendor; the latter to pay the expenses of transportation and refund the purchase money. (2) The public health service to investigate the herd from which the tuberculous animal came, and brand all tuberculous cattle found destined for any purpose except slaughtering. The vendor to stand the partial or total loss when meat is confiscated on account of tuberculous lesions. (3) No indemnity to be paid to the owner of the cattle except when an animal is ordered to be slaughtered on account of tuberculosis of the mammary glands, or when a mistake has been made in the diagnosis.

With these regulations in force, the tuberculous animal would have to be kept at home, and hence could not start new foci. It would have very little commercial value, as it could not be sold for anything except butchering, and not even for this if the disease is far advanced. The financial loss would be so great that the proprietors would spare no pains to protect themselves. This would transfer the fight against bovine tuberculosis from the authorities to private interests, instead of the latter hampering and seeking to circumvent the authorities in the task. The proprietor would not have to make any declaration, and would not be molested by any one so long as he kept his tuberculous cattle at home. He can call on authorities to help him weed out the tuberculous animals, and these he can keep separate from the others and send to the slaughter-house at his convenience, while the rest of his herd is kept safe from infection with tuberculosis. He can take his own time and means to eradicate tuberculosis from his herd, and none of his tuberculous cattle need be

branded if he does not attempt to sell them for any purpose except butchering. This prophylaxis based on private interests will act everywhere throughout the country at once, and will be kept up until bovine tuberculosis has disappeared. Lignières urges legislators to pass a law nullifying the sale of a tuberculous animal for any purpose except butchering, and providing for branding as described above.—*Contribution à la prophylaxie générale de la tuberculose bovine, J. Lignières, Bull. d. l'Acad. d. Med. December 23, 1919, lxxxii, No. 41, 505.*

Colonization of Tuberculous Soldiers and Families.—The tuberculous have an economic value, and this value must be properly developed. This can best be done by colonization under medical supervision. Functional ability must first be developed, and this is primarily a medical problem; technical training must be given as soon as physical conditions permit, and, properly supervised, is an important aid in the development of functional ability. Functional perfection and technical ability properly developed finally lead to competing ability—the ability to return to industry under normal industrial conditions. At least two years under supervision is necessary after the sanatorium treatment is completed, to reach competing ability. Families should be included in the supervised colony, as this preserves normal human relations and standards, and under medical supervision is entirely safe for the children, tending to develop immunity through exposure to limited infection. Every occupation is open to the tuberculous, and the colony should be a school to train the man for the work for which he is best fitted. Colonies should not be isolated, but should be near large centers; they should be governed by the inhabitants but subject to medical and sanitary supervision. The Federal Board for Vocational Education has under its control a number of discharged soldiers with manifest tuberculosis. When, under proper treatment, the patients reach the quiescent stage with negative sputa, they are admitted to training in certain schools, but under medical supervision of the Public Health Service which supplies a full time medical officer and nurse where twenty-five or more are grouped in one institution. The number of studies, hours of study and rest, exercise, diet, living quarters and social life are carefully regulated. So far 275 patients are receiving training in three state universities, two state agricultural colleges, five business colleges and other schools, under expert medical supervision.—*Government Colonization of the Tuberculous Soldiers and their Families under Medical Supervision, W. H. Watterson, Chicago Med. Rec., December, 1919, xli, No. 12, 462.*

Methods of Infection.—The main channel of infection in respiratory diseases has confused scientific men for a long time, especially as regards pulmonary tuberculosis. In addition to the various theories of infection, the theory of latency in the lymph glands has arisen. The consideration of the eye as a channel of infection has been entirely neglected until Maxcy demonstrated that it might be one of the least protected regions of the body, by showing that *B. prodigiosus* introduced into the conjunctival sac can be recovered from the nose in five minutes, from the throat in fifteen minutes, and from the stool in twenty-four hours. A number of points of direct interest in the problem of the eye as an avenue of infection were left unsettled by Maxcy. These factors seemed worthy of further investigation: Whether the microörganisms really ever reached the respiratory tract below the epiglottis and vocal cords and how long they remained there; what course the microörganisms followed after instillation in either eye; how long they persisted in the nose, pharynx or larynx (the studies reported by Maxcy were of only thirty minutes' duration), and since it has been suggested, though not authentically demonstrated, that microörganisms can enter the lungs by way of the intestinal tract in experimental animals, whether this could occur in man. It was with a view to corroborating and elaborating the work initiated by Maxcy that the experiments to be described were performed. The experiments were carried out on tuberculous patients, capable of expectorating sputum. The time factor after instillation, the course followed, the distribution after ingestion were all tested, *B. prodigiosus* being used, and the authors conclude that the eye must be considered as one of the most important portals of respiratory infection. Although the greater part of infectious material entering the eye was subsequently swallowed and taken into the gastro-intestinal tract they found that a small, but definite portion reaches the larynx and trachea, where it may persist as long as a week. In passing from the eyes it traverses a definite channel, according to the eye it has entered. Infectious material that has been ingested is far less liable to reach the respiratory tract than that entering by way of the eye or nose.—*The Eye as a Portal of Infection in Respiration Diseases, H. J. Corper & J. J. Enright, J. Am. M. Ass., February 21, 1920, lxxiv, No. 8, 521.*

Direct Infection in Tuberculosis.—The large number of possible sources of infection makes it difficult to estimate the frequency of direct (patient to patient) infection in tuberculosis. An investigation by the author in South Devon, a rural or semi-rural district, showed that in the first series of 252 cases of all ages, 102 were due to direct infection, 47 to remote infection, 78 no traceable infection, 25 doubtful. In a new series, eliminating all children under 16, 316 adult cases showed 140 due to immediate infection, 44 remote, 112 not traceable, 20 doubtful. Among 96 children under 16, 71 cases were due to immediate infection, 2 remote, 22 not traceable and 1 doubtful. There was no selection in these cases; invalided soldiers were included, which would naturally increase the number of not traceable infections. Eliminating the soldier cases would bring the percentage of immediate infections over 50. In the consideration of the prevention of tuberculosis, this question of immediate infection should not be overlooked. The main channel of infection, and the only important one, is the sputum. Fortunately, the majority of cases of pulmonary tuberculosis are not infectious, or but slightly so, if proper precautions are taken. It is the advanced case that constitutes the danger. A short circular written in plain language should be widely distributed setting forth these facts, explaining the best means of avoiding infection. In addition there should be further study of the subject. The author suggests the frequent inhalation of a spray containing dichloramine-T to render an infective patient less infectious.—*Direct Infection in Tuberculosis, E. Ward, Lancet, January 3, 1920, 22.*

Risk to Human Beings from Open Tuberculosis Among Carnivorous Domestic Animals.—Petit emphasizes the identity of the tuberculous infection of dogs and cats with that of man and calls attention not only to the established frequency with which dogs acquire tuberculosis from man but also to the strong probability that man not infrequently contracts the infection from dogs and cats. Landouzy showed strikingly how fragments of food in taverns and restaurants became mixed with the sputum of persons frequenting these establishments and how often dogs became infected by eating the resulting bacillus laden mixture. The least common type of tuberculous infection attended with danger of transmission to human subjects from dogs and cats is tuberculous pyelonephritis with continuous discharge of tubercle bacilli in the urine. More frequently there is an ulcerative tuberculosis of the intestine, started through ingestion of infected material, and propagating the disease through the feces. Again, pulmonary tuberculosis in dogs and cats, both grossly and minutely identical in its different forms with the corresponding forms seen in man, very often results—without hemoptysis, however—in the formation of cavities opening into the bronchi. The animals do not spit, but they do cough, and in doing so disseminate bacilli widely over the carpet, chairs, clothes, and the hands of their masters. A dangerous and little known source of infection from dogs and especially cats is the tuberculous ulcers—doubtless started by scratching with claws soiled with tuberculous sputum—met with in these animals on the neck, lips, snout, forehead, eyelids or ears. These ulcers wholly fail to heal, becoming deeper and more mutilating, and sometimes reaching a large size. The pus continuously discharged from these dangerous lesions teems with tubercle bacilli. Children, playing with these animals, patting and kissing them and taking them to bed, are undoubtedly much exposed. All cats and dogs in a seriously depreciated state of health, with loss of weight, cough and diarrhea or harboring inveterate ulcerations on the face or neck, should be considered at least as tuberculosis suspects and due prophylactic measures should be taken. —*Les formes ouvertes de la tuberculose chez les carnivores domestiques, J. Petit, Bull. d. l'Acad. d. Med., November 18, 1919, 310.*

Tuberculosis as a Focal Disease.—There are, strictly speaking, no such things as local diseases. What we call general diseases exhibit their characteristic changes only in certain portions of the body, physiologic function being carried on elsewhere, but injury to the smallest and most distant parts may affect the general system in a defensive way. The typical tubercle is a typical local infection. If there is a sufficient colony of tubercle bacilli sufficiently virulent, it produces what we consider typical tuberculosis, and extends itself elsewhere in the body. The author sketches the history of tuberculosis, showing how much was learned after the causative bacillus was recognized, and its pathogenicity really demonstrated. There is only one place in the body where the single tubercle can be recognized and studied and this is in the fundus of the eye. The tubercle present in the ocular fundus varies in dimensions, being 0.1 mm. or larger, and can be watched from its beginning to its complete involution. Its connection with tuberculosis has been the subject of observations by many and has been followed out in the human eye, watching its connection with the disease in other

parts of the body. We have also lately come to identify tuberculous local infections of the retina as a causation of retinal hemorrhages, and Jackson describes the changes that have been noted in considerable detail. The tuberculous focus may occur in any part of the eye, in the skin of the lids as in lupus, and in the conjunctiva in various forms. The great obstacle to the recognition of a tuberculous focal infection has been that we were not looking for it in the right place. In Jackson's experience he has been led to look widely and accept its great chronicity and prolonged latency or arrest. Perhaps not everybody is tuberculous, but it is safest to accept every one as such, presenting symptoms that might arise from this infection. There has been at times an almost hysterical fear leading to folly and inhumanity in the treatment of victims. The preponderance of the lesion at its site of entrance is not the rule, and plays little part in determining the location of the primary focus. The most of civilized people harbor tubercle bacilli somewhere in their systems, and for the mass of us the best defense against the disease is our tissue resistance or immunity. In conclusion, Jackson says: The different forms of this focal infection are one disease—the unity of tuberculosis. A very large proportion of those who suffer such infections never suffer the conditions that were formerly recognized as tuberculosis—phthisis, scrofula, bone disease, etc. At its point of entrance, the tubercle bacillus very rarely provokes any reaction or excites a noticeable lesion. Foci of infection are established within the bodies of a great many people, where they are kept in check by tissue resistance. The overcoming of tuberculosis is chiefly a matter of building up and sustaining immunity by wise and careful living.—*Tuberculosis as a Focal Disease, E. Jackson, J. Am. M. Ass., February 14, 1920, lxxiv, No. 7, 433.*

Predilection of Air Vesicles to Tuberculous Implantation.—*Summary*: (1) The bronchi are accompanied by smooth muscle fibres throughout; at their distal ends all these fibres cease, but a ring of unstriped fibre guards, at these ends, the entrance into the air vesicles. (2) Within the walls of the bronchi a fine network of lymphatics lines the entire walls throughout, but it stops abruptly at the ring of muscle fibres situated at the terminal ends of these tubes. (3) Ciliated cylindrical epithelial cells line the entire bronchi with the exception of the alveolar ducts, the terminal bronchi, which are lined with a cuboidal epithelium. Both the ciliated cylindrical and the cuboidal epithelial cells are of the nucleated variety and they do not extend beyond the ring of muscle fibres mentioned above. But (4) the epithelium which lines the alveolar walls, the air sacs, distal to this ring of muscle fibres, is of the polygonal variety. These epithelial cells are all non-nucleated; within the walls of the air vesicles no lymph vessels are found nor are muscle fibres demonstrable. But it was also observed (5) that epithelial cells which are non-nucleated are short lived, are easily destroyed, have no resistance or defense power and can not protect themselves against foreign bodies, like bacteria, dust particles, tubercle bacilli, etc. (6) It is known that on the living, healthy nucleated epithelium, lining the bronchial tubes, the tubercle bacillus is perfectly harmless. For that reason pulmonary tuberculosis never has its origin in these tubes. Air vesicles are all lined with polygonal cells, which are non-nucleated and which are situated beyond that ring of muscle fibres, which, if competent, that is, in perfect health, will prevent the entrance of the tubercle bacillus upon pulmonary tissue where it grows and vegetates most readily.—*Why Have Both the Primary Focal Infection and the Subsequent Pulmonary Tuberculous Disease Their Origin Nearly Always in the Air Vesicles and not in the Bronchial Tubes? J. Ritter, Ill. M. J., April, 1920.*

Tissue Injury in the Development of Tuberculosis.—As a rule tuberculosis is a chronic condition with exacerbations as a result of the extension of the disease process into normal tissue. In many cases tuberculous patients have had tubercle bacilli circulating through their bodies for several years. Under these circumstances injuries to the tissues are of importance in determining the localization of tuberculous complications. The author cites two cases of chronic pulmonary tuberculosis in which injury to the knee resulted in the development of tuberculosis of the knee joint; one case in which an injury in the vicinity of the right ilium and a later injury to the ankle resulted in the development of localized tuberculous processes; and a fourth case in which an injury to the hand resulted in tuberculosis of the small bones in the injured area. While complications do not always develop in tuberculous patients following injury, such injuries should be avoided as much as possible.—*Tissue Injury an Important Factor in the Development of Tuberculosis, H. F. Gammons, Boston, M. & S. J., January 29, 1920, clxxxii, 119.*

Trauma of the Chest and Pulmonary Tuberculosis.—In this instalment of his long article, Tecon gives the details of twenty-seven cases of war wounds of the chest among soldiers of the Allied armies interned in Switzerland. Tuberculosis had been assumed in all, but only 18.5 per cent had tubercle bacilli in their sputum. In only 7.4 per cent was there any evidence connecting the pulmonary lesion with the war wound. All the men had been long in captivity in Germany, and yet notwithstanding the depressing conditions of their imprisonment, tubercle bacilli only very rarely invaded the lungs and only exceptionally settled at the site of the war wound. This was the more remarkable as some of the men had old tuberculous glandular lesions. Tecon examined further 1033 known tuberculous interned soldiers and found that only 1.1 per cent had had a chest wound at any time, thus confirming his assertion of the rarity of pulmonary tuberculosis consecutive to penetrating wounds of the thorax.—*Traumatismes thoraciques et tuberculose pulmonaire chez les soldats des armées alliées internes en Suisse, H. Técon, Rev. Méd. d. l. Suisse Rom., August 1, 1919, xxxix, No. 8, 361.*

Occupation and Tuberculosis.—In a general article on occupational causes of ill health, the author says that we have only recently begun to appreciate to how great a degree certain dusty occupations, or those in which ventilation is inadequate, or those in which fatigue and other factors lower the bodily resistance, lay the foundation for tuberculosis. Among stonecutters, for instance, 50 per cent of the deaths occurring in two years among the members of one union were due to tuberculosis. In order to gain control of this disease we must give due attention to the importance of these industrial factors, as well as to housing, diet and personal hygiene. Tuberculosis is in no small measure the index of the industrial sanitary conditions in any given community, because good industrial sanitation, improved housing and better living conditions generally go hand in hand, and with them a diminution in the prevalence of tuberculosis.—*Causes of Occupational Diseases, L. T. Harris, N. York M. J., November 29, 1919, cx, No. 22, 880.*

The General Symptoms of Ulcerating Pulmonary Tuberculosis in Infants.—The general symptoms of ulcerating pulmonary tuberculosis in infants must complete the very limited and deceptive local symptomatology. The physical signs of a cavity in the lung are late in appearing if we except a fixed and persistent dulness over the apex; the remainder are hardly worthy of consideration, so little importance can be given them. The general symptoms do not in themselves allow the clinician to differentiate the serious ulcerating forms from the commonplace types of infantile tuberculosis, but they occasionally offer a clinical picture having a characteristic aspect. Fever in infants with a pulmonary cavity is very inconstant and irregular. It may be high, remittent, or continued; there may be a subfebrile state with remissions and it can be truly said that all types of temperature may be indifferently met with. Very high pyrexia is due to the final acute meningeal episodes. The cavity in infants does not, like that in adults, appear to be itself the cause of the pyrexia, and hectic fever does not occur in them. On the contrary, cases of extensive ulcerating pulmonary lesions in infants may be quite apyretic. That apyrexia is common in tuberculous babies is well known, but it is interesting to know that it also occurs when cavities are present. It is probably an indication of a weak general reaction which is also made evident by the slight intensity of tuberculin reaction in infants. The antireaction may be wanting in infants with a well advanced pulmonary tuberculosis, as is often the case in young children. Besides these signs, which are rather the negative elements in the diagnosis of cavernous tuberculosis in infancy, there are other very important symptoms which arise in the digestive tract. These have been well studied by Barbier. Their habitual grouping should lead one to consider them as essentially the result of hepatic insufficiency, or better still, a multiglandular digestive insufficiency. Infants who present these symptoms have irregular stools, indicating an intestinal paresis, the intestine being no longer stimulated by its own or annexed glands. The feces are thick, massive, lacking in color, with a fatty appearance and with a stale or frankly fetid odor. Triboulet's test gives the reactionary biliary deficit, while chemical analysis reveals a defective utilization of fats. The putrid odor of the stools indicates pathological fermentation at the expense of the albuminoids. All these phenomena reveal a profound disturbance of the hepaticopancreatic function. Diarrhea may take the place of the irregular stools, especially toward the end of the process and the cachexia then makes rapid progress. Anemia is the fatal consequence of this digestive insufficiency. It is early in appearance and intense and may largely occupy the scene. A tumefaction of the

liver and spleen which may accompany the anemia is interesting, but it is far from being usual.—*Editorial, Med. Rec., November 29, 1919, xcvi, 887.*

Pulmonary Condition Found in Warfare.—The symptoms in the condition reported on are cough, sticky sputum, slight hemorrhage, and great breathlessness, amounting in some cases to paroxysmal dyspnea. There is dulness in the right infra-clavicular region, bronchial breathing, inspiration being accompanied by numerous râles of varying coarseness, and there is usually loss of weight, strength and appetite. In fact, the patients present all the classical signs and symptoms of pulmonary tuberculosis, with this exception, that there is always a consistent absence, even with refined tests, of tubercle bacilli in the sputum. The patients are persistent mouth breathers, which is due to a well defined deflection of the nasal septum. These patients are generally found among the wounded, who have lain for a long time exposed on the field. The drug treatment of the pulmonary symptoms consists in administration of iodid of potassium and arsenic. However, the main part of the treatment is the diet, which must consist of food in which carbohydrates are reduced to a minimum, with the addition of from 2 to 2.5 liters of milk per day and, if it agrees, cod liver oil in small and increasing doses. As soon as the normal weight is attained, there is an amelioration of the pulmonary condition—*A Pulmonary Condition Found in Warfare, A. Stewart & W. A. Robertson, M. J. of Australia, October 25, 1919, ii, No. 17, 348.*

Undulating Fever in Tuberculosis.—Burnand warns that the only way to keep an instructive record of the temperature in the tuberculous is to record it at least four times a day, at 8, 2, 6 and 9 and join together the figures for the different months in a single curve. By doing this in hundreds of cases at the Leysin sanatorium, he discovered a special wavelike course in seventy-two cases, and a similar course of the temperature within physiologic range in ten patients. Study of his cases seems to show that this undulating type of temperature corresponds to a peculiarly tenacious form of the infection, with insufficiency of the defensive processes and a diffuse, septicemic toxic type of the bacillary lesions. In thirty-nine cases the charts showed a rise and fall from 38°, 39° or 40°C. to nearly or quite 36°C. in two-day periods as a rule, and all except one of these patients died in from three to fifteen months. The undulating temperature within the so called physiologic range corresponded to a much more benign infection, but likewise diffuse, hard to locate and particularly tenacious and chronic. Tuberculin offers the best prospects in treatment in the milder forms of this undulating temperature course.—*De la fièvre tuberculeuse a forme ondulante, R. Burnand, Ann. d. Méd., June 1919, vi, No. 2, 110.*

Hypertension in Tuberculosis.—Although tuberculosis is usually mentioned as one of the great factors in lowered blood pressure this should not blind us to the fact that increase of tension is often present in the individual case. Colbert has analyzed a number of these cases and publishes his results in the *Journal de médicine et de chirurgie pratiques* for September 25. He finds that in chronic pulmonary phthisis hypotension is the rule. The tension diminishes during an access of the disease, and when improvement sets in it increases again. With recovery the tension is within normal bounds. The author restricts his material by excluding subjects over forty years of age and those whose tension is below 18 Pachon as a maximum. He finds increased tension due to various causes as forced feeding and renal complication. He further eliminates the association of tuberculosis with all hypertensive diseases, such as syphilis. Finally he insists that the cases must be or have been of the open bacillary type.

The old idea that a hypertensive tuberculous subject must have kidney disease is exploded by the author's finds. In 300 cases studied over an interval of four years he found 15 who appeared to have an idiopathic hypertension. Among these the maxima by Pachon's scale were 25–26 and the minima 10–11. The pulse was often very rapid just as in the hypotensive. In the hypertensive there is a natural tendency to hemoptysis. The general health in these cases is often surprisingly good, and it is not unlikely that the connection long known between recurrent hemoptysis and a good prognosis for life is associated with elevated blood pressure. Not all hemoptysis is of this type and the so called congestive form seems most akin to it. At the time of the hemorrhage the patient has no fever and is not in the midst of an exacerbation of the disease. The author finds in his own material the same prognosis. When the tension is very high—20 Pachon, for example—it requires treatment. Nitroglycerin and emetine are valuable for reducing the tension promptly. After the hemorrhage has begun the treatment comprises rest, an intramuscular injection of emetine and revulsives.—*Editorial, Med. Rec., November 29, 1919, xcvi, 887.*

Action of Tuberculosis on the Psyche and Character.—As a sanatorium director Amrein is evidently guided by his own experience but his paper is written with some reference to one on the same subject by Romisch in 1904. The psyche in this connection implies the inner existence and the character the outward expression. Naturally the specialist in a long career sees all kinds from irresponsibles to heroes. The psyche and character of the child victim may be omitted in this connection although when the adult consumptive has suffered in childhood from tuberculosis, the early experiences must powerfully affect the mind in one way or another. Most consumptives are young adults or old adolescents whose characters have not had time for development. Other writers on the subject seem to have assumed tacitly that the victim has reached sufficiently mature years to show some responsibility. In such a case there must be a great conflict between the inclinations and the fate which seems to impend. The beneficent effects of work upon the character may not be realized if the subject is an invalid and under strict treatment. The victims are often young people of unusual talent and promise who are ambitious for themselves or others. Incapacitated for work they must think and speculate. They become introspective and upon the one subject of their disease. They read popular articles about consumption and how to avoid and cure it. A singular fact even on the part of the scholarly is a form of the deterioration of taste. While at first one notes the taste for the classics these are in time replaced by stories of crime and its detection. The decline does not stop here, for the next step is to read the frivolous and then to be indifferent to all literature. Even the newspapers pall. In other words the patient suffers from a progressive secondary neurasthenia which goes far to explain his mental make-up. He may even be classed as psychasthenic with his obsessions of using the thermometer at all times and much behavior of the same type. If fairly able to get about he indulges in alcohol and flirtations and his motto seems to be "*carpe diem.*" Idleness is largely responsible for all moral delinquencies, plus the tendency to make the most of what remains of life. His behavior is not paradoxical but about what it would be under his peculiar circumstances.—*Die Tuberkulose in ihrer Wirkung auf Psyche und Character, O. Amrein, Corr. Bl. f. Schweiz. Aerzte, August 28, 1919, xlix, No. 35, 1300.*

Gastric Disorders as an Early Sign in Pulmonary Tuberculosis.—The author reports two cases in which the chief symptoms were gastro-intestinal, including constipation alternating with diarrhea, nausea and vomiting, and pain or a lump-like feeling in the epigastrium. Both had been treated for gastric disorder without relief. They complained of being constantly tired with no refreshment from the night's sleep and showed loss of weight and a rise of temperature in the afternoon; one patient perspired profusely in the early morning. The second pulmonic sound was accentuated. Auscultation in case I showed broncho-vesicular breathing over the left apex and a few dry râles over the acromion (Abraham's sign); in case II, prolonged expiration over right apex approaching the bronchial type, with râles. Blood, sputum and urine analyses were negative. As early pulmonary tuberculosis was suspected, rest, good food, and open air treatment were advised. Case II improved in a short time, and found employment in the country, reporting that he feels entirely well. Case I was kept under observation, and in about two months developed cough with bloody expectoration, and tubercle bacilli in the sputum. Under regular treatment for tuberculosis with change of climate, she made a complete recovery. These two cases emphasize the necessity of a complete physical examination, especially of the lungs, in all cases of gastric disorders.—*Gastric Disorders as an Early Sign in Pulmonary Tuberculosis, J. Katz, N. York M. J., October 18, 1919, cx, No. 16, 649.*

Reducing Mortality in Pulmonary Tuberculosis. Clinical experience proves that tuberculosis is curable if diagnosed and treated properly at the right time. Hence early diagnosis is the first important factor in reducing the mortality from tuberculosis. If the tubercle bacilli could be isolated before any damage is done, mortality would unquestionably be reduced to a minimum, but since this cannot be done in the present state of knowledge, a number of symptoms must be taken into consideration in the diagnosis. Pottenger has classified the more important early symptoms as follows: (1) Symptoms due to toxemia—malaise, run down feeling, lack of endurance, loss of strength, nervous instability, digestive disturbances, loss of weight, increased pulse rate, night sweats, rise in temperature; (2) symptoms due to reflex causes—hoarseness, tickling in the larynx, cough, circulatory and digestive disturbances, chest and shoulder pains, flushing of

face; (3) symptoms due to the tuberculous process—frequent and protracted colds, spitting of blood, history of pleurisy, rise in temperature. Many condemn the subcutaneous tuberculin test, yet the Moro and von Pirquet tests are frequently used on account of their simplicity. The X-ray, if employed by a competent man, is of value. The organization of a sufficient number of commissions of competent diagnosticians is necessary to aid the individual physician and to inspire the confidence of the patient. Next to early diagnosis, proper provisions for treatment are necessary in the fight against tuberculosis. Because the disease is most prevalent among the poor, the State must aid in the establishment of a sufficient number of sanatoriums where patients can go for treatment in the early stages before their powers of resistance are greatly diminished.—*The Problem of Reducing the Mortality from Pulmonary Tuberculosis, S. A. Savitz, N. York M. J., December 27, 1919, cx, No. 26, 1068.*

Chest Examination in 1300 Cases Referred for Gastro-Intestinal Study.—The fact that gastro-intestinal symptoms frequently have their source of origin above the diaphragm is shown by the findings in 1300 cases referred to the authors for gastro-intestinal study. A complete examination of the chest by stereoplates and fluoroscope was made in 807 of these cases; a fluoroscopic examination alone in 304; no chest examination in 189. Definite pathology was demonstrated in 506 of the 1300 cases; of this number, the lesion was found to be in the chest in 170 cases. Lung lesions were found in 98 cases, and of these 84 were tuberculosis. The tuberculous cases therefore comprise about 6.5 per cent of the total number studied, or more than 7.5 per cent of the cases in which the chest was examined. Coincident lesions of the lung and gastro-intestinal tract were noted in only six instances. The gastro-intestinal symptoms were of secondary origin in practically all of this group. Most of the tuberculous cases were of a chronic, slowly progressing type, many with extensive infiltration and fibrosis, which had escaped recognition through years of semi-invalidism. Some fairly early lesions were also recognized but this was rather exceptional. It is noted that pulmonary tuberculosis was found in almost exactly the same percentage of cases as duodenal ulcer.—*Analysis of 1300 Cases Referred for Gastro-Intestinal Study, with Special Reference to the Importance of Chest Examinations in such Cases, T. A. Groover and A. C. Christie, Am. J. Roentgenol., November, 1919, vi, No. 11, 571.*

Accuracy in the Diagnosis of Tuberculosis. As a member of the Advisory Board in the selective service examination, the author found many cases of incipient tuberculosis in men who considered themselves in the best of health. The necessity for the greatest care and accuracy in diagnosis is emphasized by these findings. The following are the most typical symptoms of early tuberculosis: hemoptysis; slightly accelerated pulse and slight rise of temperature in the afternoon; fatigue on slight exertion; loss of weight; short cough with or without sputum. For a thorough physical examination, the patient should be stripped to the waist, and seated at ease with muscles relaxed. The retractions above and below the clavicles, deformity of the chest, atrophy of muscles and limitation of movement of the affected part can be studied by the use of the thoracimeter. The muscular spasms described by Pottenger can also be detected with this instrument. Palpation is an aid in estimating resistance, fremitus and movements of the chest, also in determining muscular spasms. Percussion is useful in mapping out the apical isthmus A slight alteration in the pitch of the percussion note appears early. Auscultation is, however, the most practical method for detecting incipient tuberculosis. Fine persistent râles limited to one portion of the lung that do not disappear on coughing are the most trustworthy sign. In normal children auscultation over the spinous processes shows tubular breathing as low as the bifurcation of the trachea; in the case of enlarged mediastinal glands, tubular breathing is heard lower down. In questionable cases repeated examinations should be made, and all methods used, including complement fixation, skin tests and the roentgen ray. The von Pirquet skin test has proved of some value in the author's clinic, especially in children.—*Necessity of Accuracy in the Diagnosis of Tuberculosis, M. J. Fine, Med. Rec., November 22, 1919, xcvi, No. 21, 831.*

Roentgenological Determination of Pulmonary Tuberculosis.—A roentgenological study of approximately 600 cases of pulmonary tuberculosis was made at Camp Lewis, Washington. In about 300 cases clinical and physical findings were recorded, and laboratory findings noted in the small percentage of cases in which they were positive. The study was made by screen, single plate, stereoscopic plates and by combination of plate and screen. The conclusions drawn from these studies are as follows: The definite determination of

tuberculosis is possible at every stage by the roentgen ray alone, but physical examination is usually necessary to determine the stage and activity of the process. In the incipient stage both plate and screen show definite haziness, peribronchial infiltration, and a marked degree of lessened illumination upon coughing or deep inspiration. In the cortical type the clinical findings are more pronounced than the roentgen evidence, in the peribronchial and bronchopneumonic type the reverse is true. After fibrous infiltration takes place the roentgen findings are almost pathognomonic for the disease, and to a lesser degree for the stage of activity. After calcification takes place the diagnosis of tuberculosis is definite and the degree of activity suspected. In the ulcerative type, acute, subacute and chronic cases, and healed cavities can be distinguished; these must be differentiated from small emphysematous blebs. The latter show no capsule, but an irregular outline; they illuminate upon coughing and contain no fluid in their uninfected stage. In the deep peribronchial type of tuberculosis there is indication of peribronchial infiltration and a fuzzy appearance of the bronchovesicular tree. The existence and activity of massive hilum tuberculosis cannot be definitely diagnosed. In disseminated tuberculosis the lung picture shows nothing definite unless healing takes place with small areas of calcification. The roentgenological picture of acute tuberculous bronchopneumonia in which a peribronchial parenchymal involvement is superimposed upon a chronic fibrous process, is typical. The two most generally recognized pathognomonic signs of pulmonary tuberculosis are lime-salt deposits in the upper quadrants which do not necessarily indicate activity, and the cavity which usually does indicate activity. Calcification areas indicate that there has been at some time an active tuberculous process. If in addition there are indications of fibrosis with no emphysema and little or no retraction, activity is indicated. Tuberculous excavations are unmistakable if studied by plate and screen and indicate activity. They are usually found high in the upper quadrants and are often multiple or bilateral. Any abnormality found in the upper quadrants should suggest the probability of tuberculosis, unless some other condition is definitely proven. A roentgen study is indispensable in treatment by artificial pneumothorax.—*Roentgenological Determination of Pulmonary Tuberculosis, F. E. Diemer and I. H. Cramer, Am. J. M. Sc., December, 1919, clviii, No. 6, 871.*

Cavity Formation and Annular Pleural Shadows in Pulmonary Tuberculosis.—Cavities in the lung are indicated roentgenographically by an area of transparency, greater than the normal transparency of the surrounding lung tissue. Cavities may have a clear cut, sharply demarcated outline indicating a fibrous wall or they may have irregular obscure outlines. Circular or oval areas, even and regular in outline, predominate in the majority of cases. Cavities must be distinguished from true pleural annular shadows, with and without pulmonary disease and from false annular shadows of intrapulmonary bronchial origin. True pleural annular shadows are in most cases larger than true cavities, and of more irregular outline. They appear to be more superficial and are less likely to occur in the apical region. Both of these conditions must be studied in relation to the underlying lung conditions. Intrapulmonary annular shadows occur just outside the hilum area. They are rarely mistaken for cavities, but may be confused with pleural annular shadows. In most cases there is a well defined communication between the shadow and the bronchi. They are rarely seen in the second or third stage of tuberculosis. To make a correct diagnosis, roentgen findings must be correlated with physical findings, and repeated examinations must be made. In the U. S. Army Hospital No. 16 during one year 449 cases were definitely diagnosed as having tuberculosis of one or more lobes; among this number there were 74 cases of cavitation, for which the roentgenological findings are given in tabular form.—*Cavity Formation and Annular Pleural Shadows in Pulmonary Tuberculosis, J. A. Honeij, Arch. Int. Med., January 15, 1920, xxv, 63.*

Significance of Annular Shadows.—It has been customary to interpret all annular shadows in chest plates as cavities. In a chest examination made by the author about a year ago an annular shadow was found, apparently typical of a cavity, but plates made several weeks later showed a marked diminution in the size of the supposed cavity and an absence of fluid, indicating that the first interpretation was at fault. A search of the literature and a study of numerous plates at the Trudeau Sanatorium revealed the fact that annular shadows may indicate the presence of localized pneumothoraces, and not cavities. In making a differential diagnosis between the two, it is found that in the localized area of decreased density (pneumothorax) the outline is irregular both as to contour and density and shades off gradually into the

surrounding lung tissue. The pathology in other portions of the lungs should also be considered, as cavities would be rare in miliary tuberculosis and also in the common type of peribronchial tuberculosis. The best method of differential diagnosis is the taking of serial plates, for changes in cavity formation from week to week are very slight, but in localized pneumothorax they are quite marked. Clinically air pockets indicate a progressive tuberculosis, for they cannot develop unless there is ulceration or rupture of the lung tissue, but there is a great difference in prognosis between a case showing local destruction of lung tissue as in cavity formation and one showing a localized collection of air between the pleura with a superficial involvement of lung tissue, as in pneumothorax.—*Significance of Annular Shadows, W. A. Evans, Am. J. Roentgenol., October 1919, vi, No. 10, 510.*

Threshold-Percussion in Bronchial Lymph Node Tuberculosis.—The author gives a rather extensive review of the many opposing views held by different German clinicians as to the value of percussion in the detection of enlargement of the tracheobronchial glands. In an effort to establish the true status of percussion as an aid in the recognition of this condition, the author examined a series of cases by means of Goldscheider's so called "threshold percussion" in the parasternal and paravertebral regions. The material consisted of 50 children with supposed bronchial lymph node tuberculosis. Caseous pneumonias, and older children with phthisis similar to adults were excluded from the series. In all cases the Pirquet reaction was positive. The results of percussion were controlled by means of X-ray pictures.

Of the 50 cases, in 30 the percussion finding were positive and this was apparently verified by the X-ray plate. Of these 30 "positive cases" the oldest was ten years, and 21 were under five years of age. In 9 "negative cases" the percussion findings were positive (apparently showed enlarged glands) but this was not substantiated by the X-ray. In 5 cases the X-ray showed a definite gland shadow, but percussion was negative. The other cases gave such indefinite results as to be worthless for this study. The author believes, however, that very light percussion in the parasternal and paravertebral regions, especially after the manner described by Goldscheider, is a great aid in the diagnosis of bronchial lymph node tuberculosis in infants and young children, and equals in value the examination by means of the X-ray.—*Ueber den Wert der Schwellenwertsperkussion bei der kindlichen Bronchialdruesentuberkulose, F. Weihe, Jahrb. f. Kinderhk., 1919, Third Series 90, xl, No. 3, 163.*

Focal Auscultation.—Peyret recalls that sound waves are reflected back from an obstacle like light waves, the angle of reflection equalling the angle of incidence. Hence in certain conditions they converge toward the same spot. At certain points, therefore, several waves meet, and the sound therefore is louder at these points, or foci as he calls them. If, for example, a round table is percussed, the point of greatest resonance will be at the center, which is the focus where the sound waves meet. He gives diagrams showing the application of these principles in auscultation of the chest, calling attention to the points where the sound waves converge, and the lines along which there is most convergence, explaining the physical and geometrical laws governing the findings. The ear at the one focal point can hear the percussion sounds from different regions, even from the two apices. The findings are exceptionally instructive under these conditions with incipient pulmonary tuberculosis, as he has determined in examining thousands of tuberculosis suspects in the army. The method is likewise instructive for the heart, abdomen and limbs.—*Rapport sur un mémoire de M. le Dr. O. Peyret concernant l'auscultation focale, M. Léiulle, Bull. d. l'Acad. d. Med., July 22, 1919, lxxxii, No. 28, 83.*

The Diagnosis of Encysted Tuberculous Pleurisy of the Apex.—The data now in our possession lead to the conclusion that the diagnosis of encysted tuberculous pleurisy of the apex will always be a matter of no little difficulty. Numerous affections may simulate it and therefore should be considered. A pneumonia of the apex may be suspected because of the percussion dulness and absence of the respiratory murmur in the upper lobe, and throughout the area of the fluid collection the voice sounds will have a greater resonance than elsewhere. Now these phenomena are also found in consolidation, while the pain usually complained of at the onset of a pleurisy may be totally absent. A mistake is all the more easy because a certain number of cases of pneumonia of the apex—especially in children—have a single physical sign, namely, dulness, the stethoscopic signs usually being absent. However, the dulness is less distinct in pulmonary consolidation than in fluid collections and does not offer resistance to the exploring finger,

and these are the best signs to go by when a radioscopic examination cannot be had. Radioscopy will reveal in pneumonia a shadow extending over the entire apex, but, as Weill and Mouriquaud have recently shown, it is triangular in shape with the base in the axilla and the apex at the hilum, while in encysted pleurisy the lower border of the shadow offers an upward convexity. If doubt remains as to the diagnosis exploratory puncture should be resorted to.

Tuberculous infiltration of the apex, tracheobronchial lymph nodes with congestion of the apex and unilateral pulmonary and lymph node tuberculosis offer analogous symptoms—dulness and a respiratory souffle with or without râles. In children particularly the search for vocal vibration is often impossible so that the diagnosis may be most difficult. Radioscopy is unquestionably useful because a tuberculous infiltration will give rise to an opacity far less marked and much more diffuse than an encysted fluid collection, while the lower border does not show an upward convex line.

The two other affections which may simulate encysted pleurisy of the apex are hydatid cyst and cancer, both of which give rise to symptoms similar to those of the pleurisy, namely, dulness, decrease of the vesicular murmur, or bronchial souffle. Hydatid cyst usually occupies the middle portion or the base of the apex, while puncture and examination of the fluid withdrawn will settle the diagnosis in doubtful cases. Pulmonary cancer, when extensive, may involve the entire upper lobe, and puncture may not always clear up the differential diagnosis, for in one instance of malignant disease a thick yellow fluid was withdrawn.

Finally, an anterior or posterior mediastinal pleurisy may assume the clinical aspect of encysted pleurisy of the apex. However, one of the anterior mediastinum, whether a purulent or serofibrinous tuberculous pleurisy, is accompanied by more marked pain and dyspnea than that occurring at the apex. The physical signs are found lower down than those at the apex, while the dulness will be more prone to simulate a pericarditis with effusion. On the other hand, the heart will be displaced, but the beats will not be dull so that pericarditis can be eliminated. The radiological examination will reveal an enlargement of the cardiac shadow which is not animated by any beat. Empyema of the posterior mediastinum gives rise to dyspnea, spasm of the glottis, dysphagia, and hoarseness due to paralysis of the left recurrent nerve, all of which are absent in pleurisy of the apex. On the other hand, the physical signs are only to be found in the paravertebral region and radiology reveals a longitudinal opacity filling the clear median space when the thorax is examined obliquely. After all, the best means for arriving at a correct diagnosis of encysted tuberculous pleurisy of the apex is by resort to radiography and exploratory puncture.—*Editorial, Med. Rec., February 4, 1920, xcvii, No. 7, 278.*

Results from Use of von Pirquet Test. —Friedman has performed the von Pirquet test 525 times on 464 unselected patients ranging in age from a few months to eighteen years. Nearly all the children tested were of Jewish parentage, living under conditions comparable with those prevailing among the poorer working classes of the larger cities. Most of the children were of tuberculous parents, many of whom had been inmates of a sanitorium where they had had thoroughly inculcated rules of prophylaxis, which were observed scrupulously in many of the homes. Of the 465 children tested, 39.8 per cent reacted positively, the number of positives among the males being 2 per cent in excess of those in the females. Under 1 year, almost 12 per cent reacted positively; from 1 to 14 years, 55 per cent, and from fourteen to eighteen years, only 51 per cent reacted positively. The highest number of positive reactions was noted during the eleventh to thirteenth year period, with 66.7 per cent; and the lowest at the fifth and the sixth year period, with only 13 per cent positive. Of the 274 children having a tuberculous parent 53.6 per cent reacted positively; of the 181 not exposed in this wise, only 23.2 per cent, or less than half reacted. Of the nonexposed, 135 were born in Colorado, and only 20.7 per cent reacted positively, as compared with 25 per cent of the boys. Of the 126 children born in Colorado and exposed to tuberculosis, 56.4 per cent of the girls and 42.3 per cent of the boys reacted positively. Of 189 children exposed to a parent with open tuberculosis, 58 per cent reacted positively; of seventy-eight exposed to a closed case, 38.5 per cent reacted; whereas, nonexposed children reacted only to the extent of 23.2 per cent. Of those children whose father harbored closed tuberculosis, only 27.6 per cent reacted positively; and when exposed to a mother with closed tuberculosis almost double the number, or 48.4 per cent, showed positive reactions. An observation deserving recognition is, that of the female children exposed to a father with closed tuberculosis, 40.7 per cent become infected; whereas of the male offspring similarly exposed, only 10 per cent or less than one fourth react positively. On the other hand, boys and girls exposed to either parent with open tuberculosis react in about equal ratio; eight children had both parents tuber-

culous, and seven reacted positively. Tuberculous infection is said to exercise a retarding influence on the physical growth of the child. Of children reacting positively, 61.8 per cent are below normal in development, 20 per cent are normal, and 19.5 per cent are above normal. Of those with negative reactions, 56.1 per cent are below normal, 31 per cent are normal, and 12.6 per cent are above normal. Infected children under seven years of age show relatively less developmental impairment than do those above the age.—*Von Pirquet Test and Results of Its Use, E. Friedman, Colo. Med., October 1919, xvi, No. 10, 246.*

Partial Antigens in Diagnosis and Treatment of Tuberculosis.—Walthard refers to the Deycke-Much partial antigens on which so much conflicting testimony is accumulating. He applied them in the diagnosis of tuberculosis on 157 subjects, including 24 clinically healthy, 54 with bone and joint tuberculosis and 43 with urogenital tuberculosis. Only 15 of the total 157 failed to respond and 8 of these were in advanced tuberculosis; the others were normal children and young people. The titre of the response varied widely within brief periods, the conditions being apparently the same at each test. It seems as if the theory of the partial antigens is not based on solid premises, but it is important for research on immunity, and deserves further study as it throws light on many obscure points. Striking benefit was not obtained with the partial antigens in any instance, but some improvement was evident in some of the 29 cases of bone or joint tuberculosis and 5 of urogenital lesions.—*Ueber den diagnostischen und therapeutischen Wert der Partialantigene nach Deyke-Much, H. Walthard, Corr. Bl. f. Schweiz. Aerzte, October 16, 1919, xlix, No. 42, 1577.*

Diagnosis of Tuberculosis of the Kidney.—The following are the most important data upon which to make a diagnosis of renal tuberculosis: (1) Bladder symptoms.—Increased desire to urinate, at first only at night, but later diurnal; painful urination, concomitant with the frequency, which gradually becomes more and more severe; incontinence or great irritability as the bladder involvement progresses. (2) Kidney symptoms.—A dull ache or recurrent colicky pains on the affected side, or on both sides in bilateral involvement. Enlargement of the kidney is a very unreliable finding. The same is true of tenderness over the diseased kidney. Rigidity is found only when the perinephric tissues have been invaded. (3) Fever.—There is little as a rule unless there is a mixed infection or a sudden retention. (4) Urinary findings.—Pyuria may be present except in cases of closed pyonephrosis, or in the early stage of mixed infection. Hematuria may be the first symptom or may appear with pyuria at intervals. Tubercle bacilli can be found in the urine in 80 per cent of the cases by the Forssell or Crabtree methods. (5) Cystoscopy and ureteral catheterization.—This is the most important single method. Unless changes specific of tuberculosis are found in the bladder it is best to suspend judgment until the urine obtained by ureteral catheterization has been studied by culture and staining methods. (6) Pyelography and X-ray.—These yield much information as to the changes in the renal pelvis and parenchyma.—*Diagnosis of Tuberculosis of the Kidney, D. N. Eisendrath, South. M. J., November, 1919, xii, No. 11, 679.*

Fixation Reaction in the Diagnosis of Tuberculosis.—The authors applied the fixation reaction, with the technic recommended by Calmette and Massol, in 141 tuberculosis cases or suspects and in sixty subjects in normal condition or with affections other than tuberculosis. The alexin used in this method is that of fresh guinea pig serum, previously standardized. The hemolytic serum is prepared by systematic injection of goat erythrocytes into horses; it is inactivated by heat and standardized. The patient's serum is decanted and inactivated by heating to 56°C. for thirty minutes or to 58°C. for ten minutes. Two antigens are used. The first is made from tubercle bacilli extracted with distilled water and standardized by means of serum from cattle in an advanced tuberculous condition of known titre. The second is a peptone antigen obtained from an emulsion of tubercle bacilli in 10 per cent Witte's peptone, sterilized, macerated for two or three days at 65°C., filtered and standardized. Clinically, a positive fixation reaction was obtained in 77.77 per cent of the cases of known tuberculosis in the first stage; in 82.05 per cent in the second stage, and in 63.6 per cent in the third stage. In seven healthy persons the reaction was uniformly negative. Excluding all subjects of syphilitic disease in whom the reaction is frequently positive—especially when the Wassermann is also positive—patients suffering from disorders clinically other than tuberculosis furnished only 7.69 per cent of positive fixation reactions. The method is thus of marked, though not positive, diagnostic value. The presence of the antibodies in tuberculous cases does not seem to be an expression of a defensive process, but rather of a reaction to infection.

Their amount increases as the disease progresses, but in spite of their persistence, when the intracutaneous tuberculin test becomes negative, the prognosis is unfavorable. When they disappear, a fatal termination is imminent. At present the fixation reaction is in the front rank of the biological diagnostic tests for tuberculosis.—*Études comparée des faits cliniques et de la réaction de fixation dans la tuberculose avec les antigenes de Calmette et Massol, L. Boez and E. Duhot, Presse Med., September 25, 1919, No. 54, 543.*

Complement Fixation in the Diagnosis of Tuberculosis.—The technique of the tests was as follows: a, Serum inactivated at 56°C. for thirty minutes; 0.1 cc. undiluted used in test. b, Petroff's antigen, diluted with the necessary amount of salt solution as determined by titration. c, Pooled serum from 4 to 6 guinea-pigs in a 1:10 dilution. d, Hemolytic system, 0-1 cc. of 5 per cent washed sheep corpuscles with 0.2 cc. of diluted ambocepter containing 3 standard units. Known positive and negative serums were used as controls. The titrations of complement and amboceptor were incubated in water bath at 37.5° for one hour and the fixation tests in ice box for two hours, then in water bath for thirty minutes, and after addition of sheep cells and amboceptor for one hour. The tests were read immediately. Tests were made on the serum of 186 patients, 103 being active cases, 51 inactive cases; 31 non-tuberculous, and 1 tuberculosis of epididymis some time after operation. Of the 103 active cases, 15 gave ++ reactions, 1 gave a + reaction, 5 gave ± reactions, and 83 gave negative reactions; only 16 or 15.53 per cent of the active cases, therefore gave a positive reaction. Of the inactive cases 50 gave negative reactions, and one gave a reaction and also a ++ Wassermann. Of the non-tuberculous cases, 29 gave negative reactions and one a ++ reaction, and a ++ Wassermann. Of the 103 active cases, 10 gave positive sputum and positive reaction to the test, 6 gave negative sputum, and positive reaction, 41 gave positive sputum, and negative reaction, 46 gave negative sputum and negative reaction. The degree of activity in the 103 cases varied considerably, and all stages of activity were represented in the 16 cases giving positive reaction. The test is apparently of no value as a diagnostic or prognostic aid at least in the type of cases studied. Further tests with patients who had a ++ Wassermann reaction, but no evidence of tuberculosis showed that 45 out of 100 gave positive fixation tests for tuberculosis; in 100 cases with negative Wassermann reactions, but no history or evidence of tuberculosis, 17 gave positive complement fixation for tuberculosis. It is evident that the test with the antigen used is not absolutely specific.—*Complement Fixation in Diagnosis of Tuberculosis, W. H. Moursund, J. Infect. Dis., January, 1920, xxvi, No. 1, 85.*

A Case of Generalized Tuberculosis.—A young man of 18, private in the British Army, presented symptoms of a comparatively mild attack of so called influenza, followed by pain and swelling of the joints of the right hand, and slight pain in the hip, loss of weight, but no marked emaciation. X-ray photographs showed slight blurring of the carpo-metacarpal joint surfaces of the hand, no abnormality in the hip. The temperature was above normal with morning remissions. There was at one time a dry pleuritic rub at the base of the lung, and later occasional crepitation at both bases posteriorly. These signs disappeared, and no other physical signs of lung disease could be found until ten days before death about two months later. After repeated examinations of the urinary sediment, one tubercle bacillus was found. No bacilli were found in the sputum, but the X-ray showed clearly the lesions of a hilum tuberculosis spreading outwards to the surface of the lungs. Ten days before death the patient developed a slight cough, with but little expectoration, and on physical examination, moist crepitations, rapidly increasing in number, were found in each axilla. Death was due to peritonitis, which the autopsy showed was caused by the rupture of a tuberculous ulcer in the pelvic colon. There were also numerous other ulcers in the colon, and a few in the ileum. Post-mortem examination of the lungs showed conglomerate areas of fibrocaseous tubercles scattered more or less uniformly through the lung tissue, but especially evident in the upper lobes. The majority were in relation to the bronchial sheaths, and interlobular septa. The intervening lung tissue showed comparatively little change, but there was decided diffuse fibrosis.—*A Case of Generalized Tuberculosis Presenting Difficulties in Diagnosis, F. J. Nattrass, Lancet, November 15, 1919, No. 5020, 872.*

Deaths and Death Rates from Pulmonary Tuberculosis in New York City and State.—The following table and graphs, illustrating the deaths and death rates from tuberculosis for New York City and State, during the years 1913–1919 inclusive are reproduced from the *Monthly Vital Statistics Review, New York State Department of Health, March, 1920, New Series, vol. i, no. i.*

Pulmonary tuberculosis: deaths and death rates, New York State and large subdivisions, January 1913–1920*

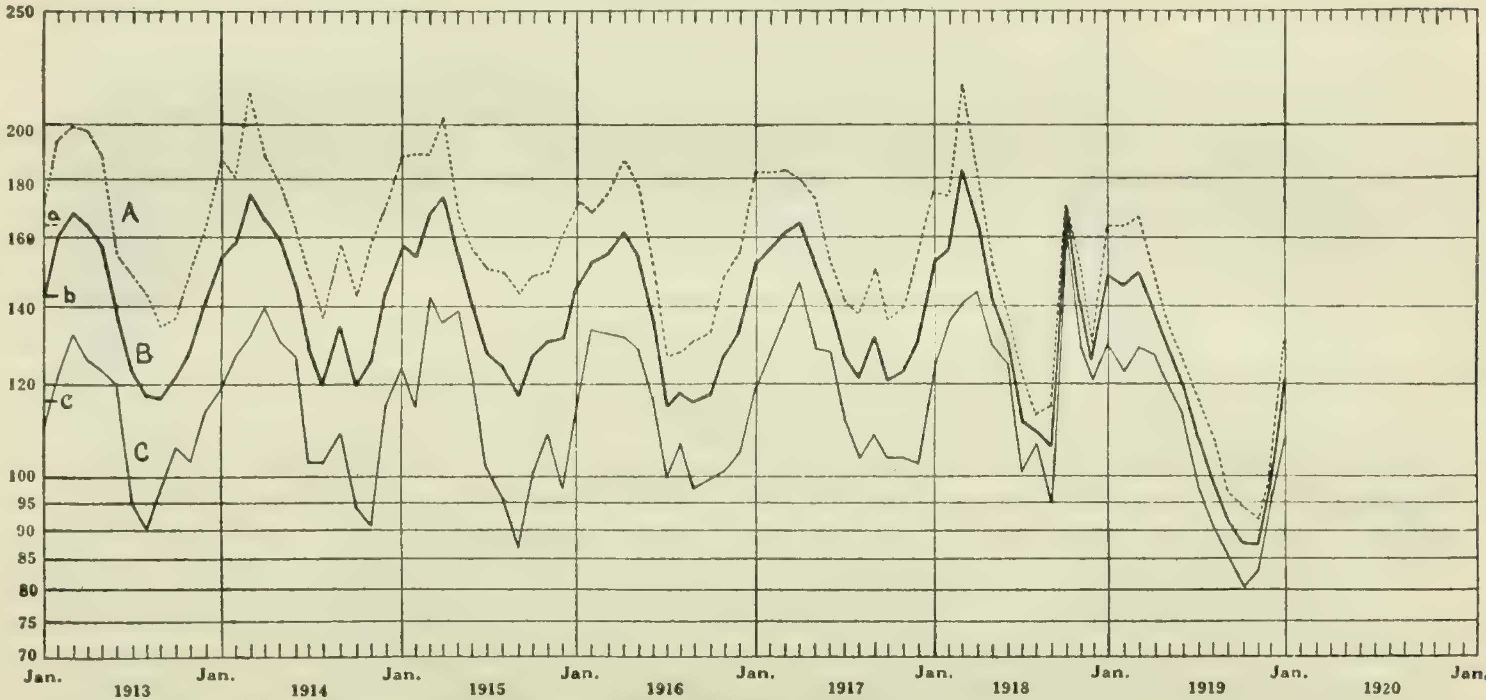
MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
January	1913–'17	1,295	150.9	833	179.3	463	117.4	239	125.0	224	110.2		
January	1913	1,183	143.1	759	171.9	424	110.3	213	113.8	211	107.5		
January	1914	1,301	154.7	840	186.0	461	118.8	248	129.8	213	108.2		
January	1915	1,361	158.4	872	187.7	489	124.1	245	128.1	244	120.3		
January	1916	1,268	145.3	809	170.4	459	115.4	225	116.2	234	114.6		
January	1917	1,363	152.9	883	181.6	480	119.2	264	134.0	216	104.5		
January	1918	1,382	152.7	873	175.4	509	124.9	244	121.6	211	101.5	54	
January	1919	1,374	148.8	836	164.2	538	130.5	241	117.9	241	115.3	56	
January	1920	1,128	120.3	682	131.0	446	107.0	208	100.6	209	99.3	29	

* Deaths per 100,000 p pulation per annum.

NOTE: Data from New York State Health Department Annual Reports and Monthly Bulletins, or specially computed.

DEATH RATE FROM PULMONARY TUBERCULOSIS: NEW YORK STATE, NEW YORK CITY, AND STATE EXCLUSIVE OF NEW YORK CITY: BY MONTHS, 1913-1919

Annual rates per 100,000 population

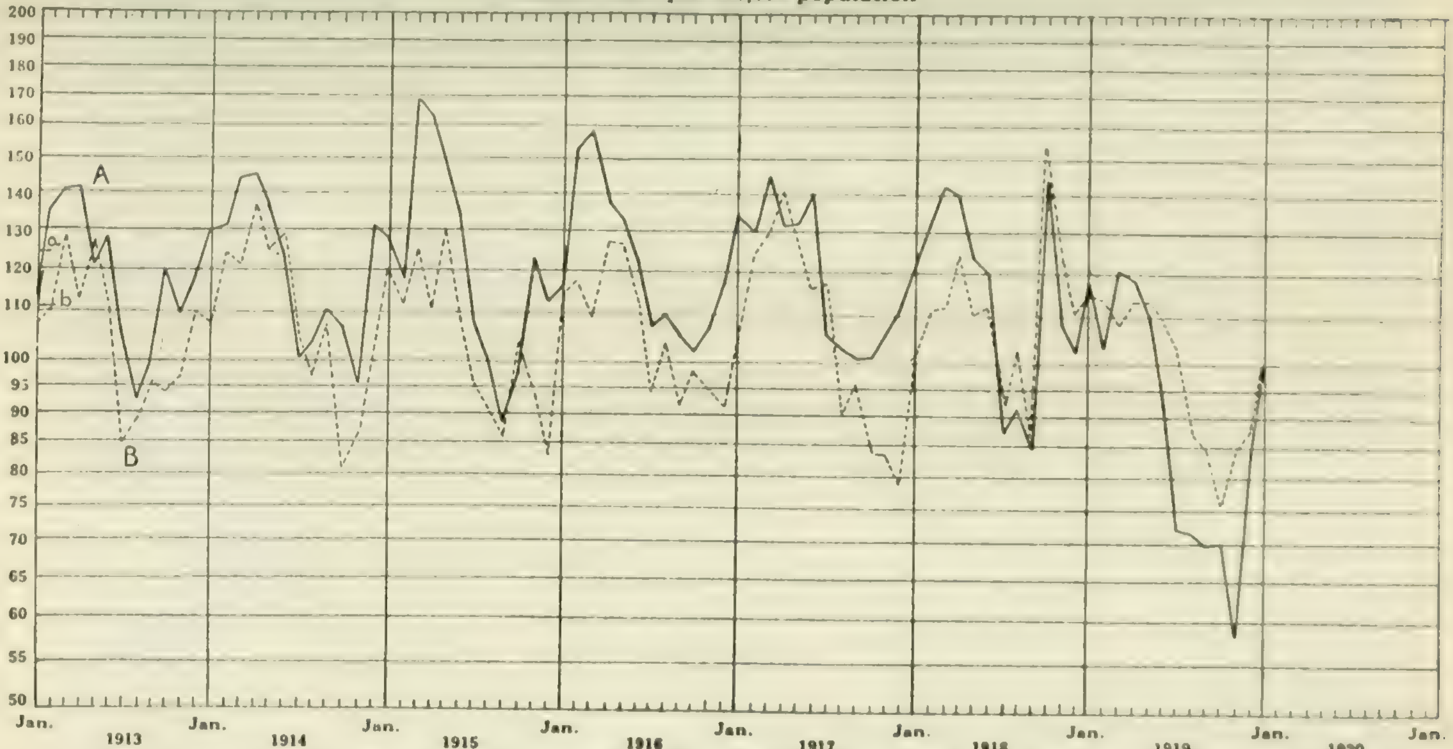


A, New York City; B, New York State; C, State exclusive of New York City

Average annual rates: 1913-1917: a, 164.1, New York City; b, 142.6, New York State; c, 117.1, State exclusive of New York City

DEATH RATE FROM PULMONARY TUBERCULOSIS: URBAN AND RURAL AREAS *(EXCLUSIVE OF NEW YORK CITY): BY MONTHS, 1913-1919

Annual rates per 100,000 population



A, Urban; B, Rural. *"Urban" includes all "cities" (except New York) and certain very large villages, and "rural" includes all remaining districts except institutional; see table No. 11. Average annual rates, 1913-1917: a, 123.9, urban, b, 110.8, rural

Innocent Tuberculosis.—A man, aged fifty-eight, had been treated twenty years previously for tuberculous ulceration of the larynx. The treatment was on sanatorium principles with a few applications of chromic acid. The larynx was healed and had remained so. He had had tuberculosis of the hip at the age of 10, on account of which he walked with a shortened leg and raised boot. The hip lesion was healed, or quiescent, at the time of the laryngeal affection. At the age of twenty-three he developed tuberculous deposits in testes, prostate and seminal vesicles, which also remained quiescent. After the larynx healed, the patient, on advice of the author, gave up his indoor life and took up nature study and outdoor photography, also lecturing and writing on these subjects. He still remains well, though weighing less than in 1900, without active tuberculous lesions, an example of the innocent, long drawn out form of tuberculosis, probably kept from more serious outbreaks by a favorable change in the mode of life.—*A Case of Innocent Tuberculosis, St. Clair Thomson, Tubercle, October, 1919, 1, No. 1, 13.*

The Cardiovascular System in Pulmonary Tuberculosis.—In a study of pulmonary tuberculosis, the detailed investigation of the lungs is, of course, of first importance, but certain disturbances of the cardiovascular apparatus also deserve attention, as they have an important bearing on the methods and results of treatment. In the author's institutional work most of the cases examined belonged to the second or third stage of the disease. In the first stage cases of apparently short duration, no striking change from the normal in the size and position of the heart could be ascertained. The sounds over the mitral and tricuspid area are usually normal; aortic sounds are normal, though frequently accentuated; over the pulmonary area, however, the accentuation of the second sound is very noticeable. Of 25 males and 25 females examined in the second stage, the measurements of the heart suggested cardiac enlargement in 10 of each sex. The second mitral and tricuspid sounds, as well as the first aortic and first pulmonic sounds are fairly normal. The first mitral sound is frequently accentuated in young and robust patients, while indistinctness, splitting and murmurish qualities are encountered in debilitated and chronic fibrous cases. The first tricuspid and second aortic sounds are frequently indistinct, accentuation being less usual, especially in men; in women an accentuation of the second aortic with reduplication is often noted. The second pulmonic sound is rarely normal, but frequently accentuated and also split; occasionally it is weak. Among seventy-five male and seventy-three female third stage cases the heart measurements showed dilatation in 50 per cent of the males, less frequently in the females. The first mitral, second mitral and first tricuspid sounds are indistinct, murmurish or roughened, while reduplication is less frequent. The first and second aortic sounds are about the same as in cases in the second stage, the second aortic sounds being somewhat more frequently accentuated. Indistinct pulmonic sounds are slightly more frequent, while splitting and accentuation of the second sounds and indistinctness are much more frequent. The figures for pulse rate, systolic and diastolic pressures and cardiac pulsation are low, especially in consideration of the fact that the patients' ages were mostly above twenty years, and often above forty. Dermography and the Aschner phenomenon with slowing and dicrotism of the pulse were occasionally present. Signs of cardiovascular failure were more marked with irregular septic temperature. Cardiovascular stimulants of all kinds frequently had neither immediate nor lasting effects. In the treatment of the quiescent stage of the disease, too much exercise without proper medical control may mean overexertion and excessive strain on the cardiovascular system.—*Therapeutic Problems in Pulmonary Tuberculosis with Disturbance of the Cardiovascular System, E. Zueblin, Med. Rec., October 4, 1919, xcvi, No. 14, 584.*

Tuberculosis of Stomach and Oesophagus.—Tuberculous infections of the stomach and oesophagus are very rare, there being probably less than 200 acceptable cases of the former and 100 of the latter on record. An acceptable case is one which presents a typical histologic picture of tuberculosis or of tubercle bacilli in the depths of the lesion. Many theories have been advanced, but the immunity of these parts has not yet been satisfactorily explained. Practically all cases are secondary, the vast majority being infected by continuity and contiguity of structure. The common lesion of reported cases of both the stomach and the oesophagus is the tuberculous ulcer. The clinical side of these diseases is almost non-existent, due to the fact that the involvement is a terminal event symptomatically overwhelmed by obtrusive, advanced, tuberculous lesions of the chest or abdomen. A case showing tuberculous ulcers of both stomach and oesophagus is herewith reported. The author enumerates 50 references for tubercu-

losis of the stomach and 38 references for tuberculosis of the oesophagus.—*Tuberculosis of the Stomach and the Oesophagus, with Report of a Case, S. W. Sappington, Hahnemann Monthly, April, 1920, lv, 227.*

Clinical Types of Abdominal Tuberculosis.—Clinical experience indicates that the widespread exudative type of tuberculous peritonitis is not usually secondary to any demonstrable lesion of bowel, mesentery, or tubes. In most cases it is probably a blood-borne infection of the serosa. It is favorably influenced by simple evacuation of the fluid. In tuberculosis of the intestines, the lower end of the ileum is the most common and the caecum, the next common, site of the lesion. In the ileum the infection attacks the mucous membrane primarily causing necrosis and ulceration. In the caecum and other sections of the large bowel, massive tumors are formed, and the intestinal wall becomes thickened and infiltrated. Operation is always necessary in tuberculosis of either the ileum or the colon when it is associated with definite intestinal obstruction. The choice of operation lies between exclusion by anastomosis and excision. If the obstruction is acute, the former is to be preferred; if subacute, the latter. A mass that is easily isolated is better removed. When such tuberculous bowel lesions are not associated with obstruction, or the obstruction can be relieved by aperients, the advisability of operation depends upon the existence of other lesions in the body. If the lungs are affected, it is usually wiser not to operate. In tuberculous disease of the rectum, surgical treatment can do little; there is no actual evidence that the establishment of an artificial anus is curative. If pelvic abscess develops, evacuation by the intraperitoneal route is to be recommended. The mesenteric glands are frequently the site of abdominal tuberculosis. When the disease is local and limited, operation gives good results. The operation of choice is either enucleation or excision of the mesentery involved with the associated bowel, according to the extent and stage of the tuberculous focus.—*Some Clinical Types of Abdominal Tuberculosis, K. W. Monsarrat, Brit. M. J., January 3, 1920, 5.*

Recurrent Spontaneous Retinal Hemorrhage of Probable Tuberculous Origin.—Tuberculosis has never been absolutely demonstrated to be the cause of recurrent retinal hemorrhages, but investigation of many cases reported in literature furnishes very convincing evidence of the probable presence of tuberculous germs or toxins. One case is reported in which the patient first came under observation after repeated retinal hemorrhages and practically total loss of vision in the left eye. The ophthalmoscopic examination of this eye showed the typical picture of retinitis proliferans; no blood vessels were visible in the mass, but the retinal vessels could be distinctly seen running through it. Examination of the right eye showed dust-like opacities in the vitreous with perivasculitis along the course of the large superior and inferior temporal veins. Chest examination showed râles in the left lower lobe. A few days later there was a large hemorrhage in the vitreous of the right eye and vision was practically destroyed (light perception only). The patient was given an injection of coagulose which was repeated a few days later, and ordered to take gelatin and 5 grains each t. i. d. of calcium chlorid and potassium iodid. Tuberculin injections were begun and continued with increasing dosage for the next six months. Within a week the right eye cleared up, and in two weeks the vision was 20/25 in this eye, although there was a large black clot in the vitreous. There were two recurrences of the hemorrhage in the next month, but both cleared up under the same treatment. The patient was in poor health and coughed considerably, but no positive evidences of pulmonary tuberculosis were found on examination. With out-of-door work and careful hygiene, he regained his health, and has had no retinal hemorrhages for ten months. The right eye still shows opacities in the vitreous; vision 20/25. The left eye is totally blind, with complete detachment of the retina.—*Recurrent Spontaneous Retinal Hemorrhage of Probable Tubercular Origin, R. H. Buck, Am. J. Ophth., October, 1919, ii, No. 10, 731.*

Diagnosis and Prognosis of Solitary Tubercle of the Choroid.—At the onset, this ocular affection is not suspected, as all objective or subjective symptoms are wanting. In the more advanced phases of the process, the lesion gives rise to indefinite ocular symptoms common to other diseases of the eye and it is only by an examination of the fundus that the peculiar character of the tuberculous pseudoneoplasm of the choroid will give a clue to the diagnosis. The solitary tubercle varies in size and never projects more than two to three millimetres above the surrounding surface. It is pale yellowish white, while its borders are gradually lost in the unchanged choroid surrounding it. Frequently, on account of secondary complications, such as corneal or crystalline opacities, it will be found impossible to distinguish the characters of the lesion in the fundus oculi. The globe presents in-

flammatory lesions and a decrease of the intraocular tension; hypotonia is a diagnostic sign of great value. But these symptoms are not sufficiently constant to be considered pathognomonic of tuberculous pseudoneoplasms of the choroid and it is only by puncture of the tubercle, followed by guinea pig inoculation with the material removed, that a positive diagnosis of the lesion can be made. The age of the patient and data regarding the general health are important for the differential diagnosis. This morbid process develops spontaneously in tuberculous subjects, usually with advanced lesions. Solitary tubercle of the choroid has been met with more frequently in subjects between the ages of two and twenty years. If the patient is manifestly tuberculous or when the pseudoneoplasm offers distinctly appreciable characters, the diagnosis is not difficult to make, although this lesion often progresses with characters belonging to true intraocular neoplasms, such as detachment of the retina or glaucomatous accidents. In solitary tubercle of the choroid, the tuberculous masses give rise to distant inflammatory reactions, such as iritis or iridocyclitis, while in the case of a malignant growth no other ocular lesion than that of the tumor itself will be found. Inflammatory phenomena are so exceptional that they should be regarded as a secondary infection superadded to the neoplastic process. A very important point to be determined for the differential diagnosis, to which Zur Nedden has particularly called attention, is the invasion and early perforation of the sclera without being preceded by glaucomatous phenomena, while during the evolution of intraocular growths perforation takes place after a rather long lapse of time always preceded by a glaucomatous phase. A malignant neoplasm invades the entire ocular globe, causing it to project outwardly. This fact has been confirmed many times. In Dupuy-Dutemps's patient the scleral ectasis was marked three months after the onset of the process, while in Natanson's second patient perforation of the sclera occurred at the end of two months. In Botesat's patient there was a marked sclerotic ectasis with perforation three weeks after the onset of the affection. After perforation has taken place the tuberculous neoplasm progresses slowly and in some cases appears to become attenuated. In malignant growths the opposite phenomenon is observed, the neoplasm developing rapidly externally and invading the surrounding structures. Spontaneous recovery from this ocular lesion rarely has been known to occur, even with complete return of the sight, but usually vision is quickly lost, especially in children, while in adolescents and adults the evolution of the morbid process is slower and more benign. A primary tubercle of the choroid appears to progress more rapidly than when it develops in a tuberculous subject, when its evolution is likely to be slower and less serious. Generalization of the process usually takes place after perforation of the sclera, but cases have been observed where symptoms of generalization were manifest before perforation had taken place.—*Editorial, N. York M. J., March 27, 1920, cxi, 560.*

Diffuse Tuberculous Cellulitis.—Some old tuberculous lesions are more or less destructive of the interstitial tissue and have a tendency to infiltrate without arousing a defensive reaction. They are represented by the metastatic abscesses and cold abscesses. They are usually post-operative, but may be idiopathic and are most common in youth. The symptoms are those of a cold abscess of very rapid growth, occurring with a bone lesion or after an operation for osteoarthritis. The skin is rapidly invaded and fistulization develops with discharge of a very small amount of pus. There is always swelling of the nearby lymph nodes and muscular atrophy with trophic disturbance of the skin. The condition, previously always fatal, is now being operated upon with success. The infected surfaces are thoroughly exposed and cauterized with carbolic acid or Memiere's guaiacol solution, which is made as follows: Water, 1000 cc., benzoic acid, 0.06, alcohol, 4 drops, guaiacol, 0.3.—*La Celulitis Tuberculosa Difusa, A. Cortes Llado, Arch. Espan. d. Tisiolog., January, 1919, i, No. 1, 97.*

Erythema Nodosum and Tuberculosis.—Erythema nodosum has been reported as following an injection of tuberculin, and under other circumstances in tuberculous patients. The author has noticed the occurrence of erythema nodosum in chronic cases of tuberculosis when the condition becomes more acute, and in patients under observation as suspects when definite symptoms of tuberculosis become noticeable. He reports five cases. It is not claimed that tuberculosis is the only cause of erythema nodosum, but that the cutaneous symptoms may be caused by many poisons, one of which is that of tuberculosis. Cases observed indicate that the constitutional peculiarity which gives rise to this skin reaction is inherited. Out of 4000 cases of tuberculosis and "contacts" under the author's observation annually, he has not seen any other skin condition, apart from the generally recognized tuberculides, so definitely

connected with tuberculosis as erythema nodosum.—*Erythema Nodosum and Tuberculosis, E. Ward, Brit. M. J., December 20, 1919, 811.*

Sarcoid Tuberculosis of the Skin.—Sarcoid tuberculosis of the skin is rare, and usually benign. The tubercle bacillus can only occasionally be demonstrated in the lesions, and a positive tuberculin reaction is rare. Sarcoid tuberculosis generally begins insidiously; when once established, it is characterized by the presence of multiple nodular masses, isolated or not, in either the dermis, the hypodermis, or both. The single nodules vary in size; they are hard and fibrous, and often movable. Usually indolent, the lesions may become sensitive to pressure or movement, and sometimes are very painful. The general health of the patient does not seem to be affected; and the condition is usually mild and curable. Ronnaud has suggested the following classification: (1) massive sarcoid tuberculosis, (2) sarcoid tuberculosis with large hypodermic nodules, Darier-Roussy type; (3) sarcoid tuberculosis resembling lupus, Boeck-Darier type; (4) lymphosarcoid type (Hougerot); (5) bacillary lymphadenoma type. The three best known and most common types are the Boeck-Darier, the Hougerot's lymphosarcoid, and the Darier-Roussy type. The first, also called the disseminated miliary lupoid type, is an eruption of hemispheric blotches, at first rose-colored, later livid or brown, never ulcerating, always symmetrical, usually situated on the face, shoulders, and extensor surface of the arms. The lymph nodes are often enlarged, and tuberculous lesions elsewhere may be found. In the Hougerot lymphosarcoid type the lesions are small, round, dermic nodules, projecting above the surrounding surface, pale rose color, with dark centers, surface smooth. The chief site is the thorax; the face, neck and limbs are rarely involved. The Darier-Roussy type is hypodermic; the lesions may consist of multiple nodules, or large patches or tumors irregularly bosselated. It is generally conceded that sarcoid tuberculosis is produced in a resistant soil by dead or attenuated bacilli, acting locally by their insoluble secretions. Several treatments have been proposed. Many writers advocate arsenic; sodium cacodylate hypodermically seems to be preferred by the majority. Hectine in the same doses as in syphilis, and arrhenal are advocated by others. The various arsenical products may be varied with good results. Darier obtained good results with old tuberculin. Radiotherapy and intramuscular injections of mercury also have been used. Any of these special measures are good if combined with proper hygiene and attention to the general health.—*Sarcoid Tuberculosis of the Skin, C. G. Cumston, N. York M. J., January 10 and 17, 1920, cxi, 67, 112.*

Tuberculosis of One Hip with Congenital Dislocation of the Other.—A boy of 3½ years presented at the first examination in May, 1916, a congenital dislocation of the right hip, which was reduced by manipulation. Both limbs were encased in plaster of Paris, the right being hyperextended and abducted 110°. In the next dressing a few months later the right hip alone was encased. In January, 1917, a large fluctuating swelling was noted by the mother on the front and inner side of the upper third of the left thigh; movement was free and painless. A radiogram showed necrosis of the ilium and upper part of the acetabulum. Eight ounces of typical tuberculous pus were evacuated. The plaster was entirely discarded, and a modified Thomas splint fitted with a bar along each side of the left limb and a joint controlled by a key opposite the right hip; in this way the right thigh could be abducted at any angle, and the left limb continuously extended and slightly adbucted. A few weeks later a sinus developed in the left groin, but this was dressed daily without disturbing the position of the limb. The sinus closed up in February, 1918, but an abscess developed in the groin and was evacuated. Later the sinus reformed, but was healed and remained so since August, 1918. At the same time the roentgenogram showed the formation of bony ankylosis at the hip joint. The abduction of the right thigh was meantime gradually diminished until the right half of the splint was removed and the patient allowed to exercise the limb. The left hip remains immobilized until a year from the complete healing of the sinus, then the patient will be allowed to get about gradually. At the time of the report, the left hip was firmly ankylosed, and the limb in good alignment; the reduced dislocation on the right side is stable, but with a little external rotation of the limb. The boy's general physical condition is good.—*Radiograms of a Case of Tuberculosis of One Hip Associated with Congenital Dislocation of the Other, A. R. Jones, J. Orthop. Surg., January, 1920, xviii, No. 1, 4.*

Congenital Dislocation of Hip Joint and Tuberculosis.—Among the 2000 cases of congenital luxation of the hip joint at the Rizzoli Institute there were two cases in which the operation for correction of the deformity, or casual trauma, was followed by rapid development of a tuberculous proc-

ess in the joint, although there had been nothing to suggest tuberculosis in the child before. In one, the deformity was bilateral, but the right joint had required more forcible and repeated correction, and the tuberculous process developed in this joint. The child came from a tuberculous family, but roentgenography had shown apparently normal conditions before the intervention. The process had developed in the older child after a trauma, nine years subsequent to the correction of the deformity. Only a few such instances are on record, and the fact that tuberculous processes only exceptionally follow the stress of correction of congenital luxation of the hip joint, testifies anew that trauma alone is not able to induce a tuberculous process in a healthy subject. With inherited or acquired taints, even slight trauma, even any transient overuse of the part, or prolonged morbid congestion may be enough to induce the localization of a tuberculous lesion.—*Tubercolosi dell'anci e Lussazione Congenita, N. Cesarano, Chirurg. d. Org. di Movim, December, 1919, iii, 549.*

False Pneumothorax.—The rare cases in which a rapid roentgenologic examination may suggest localized pneumothorax or hydropneumothorax, when in reality another condition exists, have been studied by Stivelman, under the title of false pneumothorax. These false pneumothoraces do not cause any definite subjective symptoms, and the physical findings over the area involved are those of thickened pleura with retraction of the lung tissue. There is usually a fluid level in the region of one or the other of the lower lobes of the lung, where these penumothoraces usually occur. Their appearance either fluoroscopically or on flat or stereoscopic plates is characteristic of localized hydropneumothorax. Careful observation, however, will disclose the fact that such air collections are extrathoracic and are situated below the diaphragm, which is either pushed or drawn high up into the hemothorax. When situated at the right lower lobe, such gas collections are frequently due to a subdiaphragmatic abscess. The gas formed pushes the diaphragm high up into the thoracic cavity, thus causing the adjacent lung tissue to collapse. When situated at the left lower lobe, they very frequently are due to extreme pulmonary fibrosis with marked upward traction of the diaphragm, and to a more or less dilated stomach. In the former instance the fluid level is caused by the gas-containing abscess, and in the latter instance by the stomach contents. The rarity of reports of the condition suggests the recording of all such cases, so as to avoid a great deal of inconvenience and danger in considering exploratory puncture. It is probable that instances of this condition occur oftener than are reported. Stivelman briefly reports a case of his own observation, and remarks that when these false pneumothoraces occur on the left side they need to be differentiated from transdiaphragmatic hernias, which, when not congenital, are usually due to extensive gunshot or stab wounds. Such may be recognized roentgenographically by their appearance partly above the diaphragm and partly below. He reviews some of the literature on the condition, and concludes that the diagnosis should not be difficult when one keeps in mind that these extrapleural air pouches fail to absorb the gas they contain, as is done in true pneumothorax. The height of the fluid level in a false pneumothorax varies decidedly with the ingestion of food and with the emptying of the stomach. It disappears on fasting. With the use of the fluoroscope a barium bolus may be seen to enter the supposed hydropneumothorax causing a splash and disturbing the fluid level. A localized hydropneumothorax may be simulated by a high diaphragm and stomach caused by extreme pulmonary fibrosis or gastrectasis. This should be kept in mind when an exploratory puncture is contemplated. The article is illustrated.—*False Pneumothorax, B. T. Stivelman, J. Am. M. Ass., January 3, 1920, lxxiv, No. 1, 12.*

Clinical Aspects of Tuberculoma of the Dorsal Segment of the Cord.—From the cases recorded of tuberculomata of the dorsal segment of the spinal cord it is now possible to draw a fairly accurate clinical picture. The onset of the affection is characterized by unilateral development of the disturbances. This unilateral development is noted in twenty-eight out of thirty-eight cases collected from the literature by Ackerman (*Thesis*, Paris, 1914), but in the ten other cases the onset of the affection is not given. The characters of these unilateral symptoms are of either a motor or a sensory type. According to Schlesinger the latter are more commonly observed, especially in the form of thermic paresthesias. It is to be noted, however, that this paresthesia may be present in other forms. Oberndorfer's case began with sensory disturbances. The phenomena of paresis of one of the lower limbs must be regarded as fairly common. According to a correct remark of Schlesinger, the localization of the tubercle in the anterior horn is made evident by disturbances of the motor functions and by paresthetic disturbances when in the posterior horn. In Luce's case both horns were involved and

both varieties of disturbance were present. Finally, attention should be called to a rather frequent manner of onset—it occurred in twenty-five per cent of the cases collected by Ackerman—which is of great diagnostic importance, namely, pain. This is sometimes of the truly piercing variety or it may be fixed, of the nature of intercostal neuralgia, increased by movement or sneezing; in other words, it offers the unmistakable character of radicular pain. It is probable that it is related to lesions of the posterior roots. At the initial phase the paretic phenomena extend over an entire limb. Contracture may appear later in the paralyzed limb. The tendon reflexes are usually exaggerated; those of the patella and tendoachilles are exaggerated only on the side of the lesion and normal on the opposite side. Babinski's sign is positive on the side of the lesion. In some cases this phase of unilateral exaggeration of the tendon reflexes is absent. The cutaneous reflexes are generally attenuated or absent. The disturbances of the objective sensibility may have been looked upon as absolutely essential and often as characteristic by the majority of writers. If in many cases the abolition of all the sensory impulses has been noted in the lower half of the body it is because the case was first examined at a time when the lesion had become bilateral. In a certain number of instances the maximum of unilateral sensitive disturbances is distinctly noted. It would appear that the anesthesia before becoming complete, involves certain modes of sensibility, that of the temperature being the most easily disturbed. In other cases the anesthesia is of the syringomyelic type which, when seated in a nonparalyzed leg, resembles Brown-Séquard's syndrome. As to dissociation of the sensibility—the principal symptom of the affection—it was seen by Oberndorfer fifteen times in twenty-five cases and by Ackerman eleven times in thirty-two cases. But it should be observed that these figures cannot serve as a basis for forming a conclusion as to the frequency of dissociation of the sensibility because, in the majority of cases, the onset of the process had escaped the notice of the medical attendant.—*Editorial Note, N. York M. J., January 24, 1920, cxi, No. 4, 160.*

Lung Suppuration.—The results of the study of 100 cases of lung suppuration are discussed by Wessler, who says that while abscess, gangrene and bronchiectasis are usually treated as rare clinical entities, they are becoming of more interest because of the increasing possibility of curing them by operative procedures. He prefers to consider them together under the head of lung suppuration, and gives a tabulated etiologic classification of his 100 cases, showing the larger number to follow tonsillectomy or other operations, pneumonia or grip. There were six cases following aspiration, and two were tuberculous. Other causes were represented by single instances. They may thus be divided roughly into two groups: (1) those due to the aspiration of septic material into the bronchi, and (2) those due to the various primary lung infections, including frank pneumonias and the postgrippal cases. These two groups are not only distinct in their causation, but differ also in their symptomatology and pathology. This is evident, however, only in their early stages; and in order to recognize these differences, it is necessary to observe them from their inception. The immediate result of the lodgment of infection in the bronchus is to set up a localized bronchiectasis which later invades the lung tissue and then an abscess cavity develops. Suppurative lung conditions begin, whether postoperative or postpneumonic, as a sort of local bronchiectasis. Postoperative and aspiration abscesses are twice as frequent in the upper lobe as in the lower, while the reverse condition prevails with the postpneumonic cases. The physical signs are notoriously uncertain, but the symptoms are plain. In the aspiration cases, the onset occurs after two weeks of foul expectoration with persistent fever and usually slight hemoptysis. The distinction from tuberculosis should offer no difficulty, because of the absence of tubercle bacilli, and the usual localization of the condition. Club fingers occur earlier than in tuberculosis and may be also an aid. It should be emphasized that it is not necessary to demonstrate one or multiple cavities, and such occur only in a fair percentage of cases, and only the larger ones are usually discovered. The prognosis is best in the postoperative cases, but disappearance of symptoms should not be regarded as decisive. Symptoms disappear in many postoperative cases, but recur later. The prognosis of the postpneumonic cases appears to be almost completely bad, but the patients may live for years unless complications occur, and some may enjoy considerable comfort. The medical treatment offers little hope; relief of the cough is an important matter. Acute abscess or gangrene of the lung is not usually an operative condition, but in about one third of the aspiration cases recovery takes place spontaneously in two months. Wessler has little faith in artificial pneumothorax in these cases. In two of the cases in his series in which it was performed, the trouble was aggravated and both patients died suddenly after the last insufflation. The importance

of a bronchoscopic examination is emphasized, especially before operation. Except in cases of long standing, removal of a foreign body may effect a cure.—*Suppuration and Gangrene of the Lung: A Study of One Hundred Cases, H. Wessler, J. Am. M. Ass., December 27, 1919, lxxiii, No. 26, 1918.*

Non-tuberculous Lung Conditions.—Conclusions: (1) We must recognize non-tuberculosis as a disease. (2) A large percentage, estimated at 10 to 16 per cent of diagnosed pulmonary tuberculosis, is not tuberculosis. (3) Too many of our returning soldiers are being classified as tuberculous when in reality they have perfectly normal lungs. (4) Errors in pulmonary diagnosis can be avoided by careful cultural examination of the sputum and the aid of the X-ray. (5) The epidemics of 1917 and 1918 will produce a considerable number of lung abscesses whose diagnosis as pulmonary tuberculosis is inexcusable because fatal to the patient. (6) Early recognition and radical surgery are the means of combating acute and subacute purulent complications, such as lung abscesses or localized gangrene of a lower lobe. (7) Primary tuberculosis in the adult seldom or never begins as a basal lesion. Four illustrative cases are reported. —*Pulmonary Conditions Wrongly Diagnosed as Tuberculosis, W. C. Voorsanger, Cal. State J. M., July, 1919.*

Syphilis and Tuberculosis.—Syphilis, the arch enemy of mankind, not only modifies, and usually for the worse, the course of many diseases, but also, undoubtedly, prepares the soil for numerous infections which otherwise might have been successfully resisted. We are reminded again of this by an article on the association of syphilis and tuberculosis appearing in the December issue of the new British monthly journal *Tubercle.* In this article Dr. Alfred Mirande of Paris points out that Emile Sergent by a series of experiments has not only confirmed the views of those who have shown that there is an association between syphilis and tuberculosis, but has placed the matter in a somewhat new light. Sergent's thesis is thus summarized by Mirande: Syphilis and tuberculosis are two different infections and can develop separately in the same organism. Syphilis produces a soil for the tuberculization of the infected subject, but especially does the syphilis of the father prepare for the tuberculous infection of his child. Many forms of tuberculosis, and in particular scrofula, develop most often in a favorable syphilitic soil. Perhaps the most interesting and suggestive part of the article is that which deals with the subject of tuberculosis in cases of congenital syphilis. According to Sergent, tuberculosis in a young congenital syphilitic, instead of taking on the bronchopneumonic form general in subjects of this age, develops as an excavation, the cavity being either the product of associated action of the treponema and the tubercle bacilli or of the bacilli only. In any case mercurial treatment should be commenced and will help the cicatrization of pulmonary lesions, even when the bacillus of Koch is present. In the case of a congenital syphilitic apparently without lesions, the phthisis becomes sclerotic, and as in the adult is accompanied by asthma and emphysema. Finally, Mirande remarks, it should be remembered that the frequency with which syphilis is found in the children of tuberculous parents, whoever they may be, has prompted Sergent to wonder whether tuberculosis is not often the indirect result of the inheritance of syphilitic soil, and to put forward his claim that tuberculosis may be a symptom of congenital syphilis. In making the diagnosis of a suspected phase of syphilotuberculosis, the following points should be borne in mind: Laryngeal phthisis is often a symptom of syphilis. Fibrous pulmonary tuberculosis should lead to a search for syphilis. If general tuberculosis is perhaps an indirect result of the inheritance of the syphilitic soil, syphilitic pneumopathies often conceal a hybrid association with tuberculosis, and the remedial effect of mercurial treatment is not alone sufficient evidence, when its influence on the soil is known, for discarding the possibility of the presence of tuberculosis. In children many diseases of tuberculous origin, especially scrofula, develop readily in syphilitic soil. Mercury is the treatment advocated by Sergent for the syphilotuberculous and he prefers it given by injections in the form of soluble salts.—*Editorial, Med. Rec., January 10, 1920, xcvii, No. 2, 71.*

Syphilis and Tuberculosis.—This communication from South America emphasizes the unsuspected frequency of inherited syphilis as a predisposing factor in the status lymphaticus, in asthenia and in more or less complex endocrine derangement. Even when no signs of inherited syphilis can be detected, tentative specific treatment is justified, and it may transform conditions previously refractory to all treatment. This is particularly indicated when the parents are robust and free from alcoholism, tuberculosis, malaria and lead poisoning, which might explain the degeneracy of their children. Tuberculosis so often develops on a basis of syphilis, that inherited syphilis

should be suspected, particularly in the masked cases. Tentative specific treatment in addition to the usual treatment for the tuberculosis may induce such improvement that the organism then can throw off the tuberculosis.—*Un mot à propos de la syphilis et de la tuberculose, E. Marina and M. J. C. Mussio-Fournier, Bull. d. l. Soc. Méd. d. Hôp., November 28, 1919, xliii, No. 34, 1002.*

Surgical Aspects of Tuberculosis and Syphilis of the Stomach.—Both these infections may give rise to their respective specific lesions in the stomach as well as in any other of the viscera, and in most varied forms. Regarded for a long time as very rare, they are now becoming more and more frequent as they are better known and are searched for with greater care. Although highly interesting from the viewpoint of diagnosis they are not particularly so, as far as treatment, especially the surgical, is concerned. Tuberculous lesions of the stomach are met with in the form of ulcer and pyloric stenosis, usually due to a periulcerous hypertrophy of the region. The tuberculous ulcer is very similar to ordinary round ulcer of the stomach, but has a more chronic evolution, the hyperacidity is more marked, and the lesion extends superficially rather than in depth. The latter peculiarity, combined with the special property of tuberculous lesions of engendering adhesions of the serosa, results in the fact that perforation into the peritoneal cavity rarely takes place. The prognosis is nevertheless bad; the process will not give in to medical treatment and is more prone to occur in advanced cases of the infection. The surgical treatment—very often contraindicated on account of the miserable general condition of the patient—has usually little effect upon such extensive lesions, contrary to what takes place in simple gastric ulcer, as it cannot reach the fundamental cause of the affection. When the ulcer has not developed stenosis the only surgical treatment is resection—an operation usually too serious to be entertained in these subjects. Tuberculous stenosis is an extremely serious condition and has a worse prognosis than even cancerous stenosis. Medical treatment is perfectly useless so far as a cure is concerned, and operation should be attempted when the patient's condition offers any possible chance of success. The operation may be simply a palliative one, consisting of gasteroenterostomy, which has rarely, if ever, been successful so far as prolongation of life is concerned, the limit of one to two years being the maximum, while pylorectomy is always delicate and very serious in the circumstances. Therefore, tuberculous lesions of the stomach must be regarded as most serious from all points of view and anything like a brilliant result from surgical interference should never be expected. Syphilitic lesions of the stomach are also represented by ulcer and pyloric stenosis in most instances, although other luetic lesions occur; but these seem to be rather uncommon. The diagnosis is often impossible when the patient does not present other evidences of syphilis, but when the true nature of the gastric process has been recognized an intensive specific treatment is naturally to be resorted to at once. Strictly speaking, there is no surgical treatment of gastric syphilis, any more than there is of luetic manifestations elsewhere. However, a certain number of operations for pyloric stenosis of this nature have been done, especially pylorectomy. It is nevertheless well to remember that many cases of pyloric stenosis may properly be subjected to specific treatment, and this line of treatment should be carried out in every case where other manifestations of the disease show themselves and the patient's condition permits delaying surgical measures for a sufficient time to obtain effects by intensive specific treatment. By so doing, one may have the good fortune of occasionally meeting with a case in which the stenosis will disappear, likewise the pyloric tumor.—*Editorial, Med. Rec., April 17, 1920, xcvii, 655.*

The Relationship Between Influenza and Tuberculosis.—Influenza may, as has been frequently asserted, cause a lighting up of tuberculous manifestations in subjects who have apparently recovered from a former tuberculous infection. This awakening of a tuberculosis upon the occasion of a grippal infection recalls by its symptomatology that which takes place after other infectious processes in general. The signs may be given in the order of their appearance as follows: presumptive signs represented by the hereditary antecedents of bacillosis; signs of probability made evident by a long drawn out convalescence, a low blood-pressure, the reappearance of the fever which is irregular with oscillations, the persistency of the cough accompanied by a free expectoration, a progressive decrease of the physical strength which takes the place of the increase occurring in convalescence from an uncomplicated influenza. The sign of certitude is given by the presence of the tubercle bacillus, so that a systematic examination of the sputum should always be carried out in cases of convalescence from influenza which do not frankly recover, but drag on. It should be understood, of course, that the awakening

of a tuberculous process must not be mistaken for influenzal manifestations simulating tuberculosis on account of their development at the pulmonary apex and giving rise to hemoptysis which so frequently accompanies the pulmonary lesion. Hence the importance of laboratory examination of the sputum. It is of great importance not to misconceive the situation, because a fresh development of a tuberculosis must be dealt with vigorously and with no loss of time since the soil has been weakened by the influenza and consequently is less resistant to the bacillus of tuberculosis. It is known that tuberculosis developing in the adult is usually an explosion of an old latent process, because man acquires by tuberculization a relative immunity—a kind of autovaccination. Now, when the subject contracts an infectious disease, his immunity becomes less and the organism may even present a state of antianaphylaxis, especially when the infection is as weakening as is influenza; hence the return to activity of incompletely cicatrized lesions. At the same time that organic resistance is lowered it is quite possible that a hypersensibility may exist in a tuberculous subject—a sort of anergy results from the new infection. The microbic associations are also not indifferent to this process as this association increases the virulence of the bacillus, therefore adding its very marked congestive action to epithelial desquamation which results in and consequently favors the development of the lesions. But although the associated microbic agents of influenza may exert a stimulating action upon the bacillus of tuberculosis, some data seem to show that, in other conditions, tuberculous subjects may possess a kind of indifference towards the grippe, and although apparently contradictory these can be fairly well explained. It would seem that to a certain extent these subjects are refractory to influenza, as has been shown by Bricaire, Bezançon, and Guinard. In progressing tuberculous cases influenza seems to be infrequent and is more prone to develop in patients with a mild tuberculosis. Marfan is of the opinion that tuberculous patients offer a certain immunity to this epidemic affection. That this may be the result of parabacillary microbic associations is possible. Cornil, Babes, Mosny, and Aviragnet have shown the frequency of pneumococci around foci of tuberculosis, while Veillon that of other bacteria—the streptococcus, staphylococcus, and pneumobacillus. There is no reason why individuals with such lesions should not offer a certain resistance to an infectious process whose etiological agents are the very ones encountered in influenza, at least in its more serious and complicated forms. On the contrary, in cases of long standing tuberculosis in which Koch's bacillus is asleep in the midst of a cicatrized lesion, the associates of the bacillus will have returned to their modest rôle of saprophytes. —*Editorial, Med. Rec., March 20, 1920, xcvii, 490.*

Typhoid Fever and Tuberculosis.—The coexistence of typhoid fever and tuberculosis is not infrequent. The two diseases may also be confounded in their beginnings, as miliary tuberculosis with typhoid fever, and pulmonary tuberculosis may also have symptoms simulating typhoid. The available literature reveals only one reported epidemic of typhoid in a tuberculosis institution, which occurred in the Trudeau Sanatorium in 1917. There was a similar epidemic at the West Virginia State Tuberculosis Sanatorium during August and September, 1919. In seeking for the source of infection an investigation of the sewerage of the sanatorium was made. As a creosote disinfectant was used in the lavatories, the taste and odor of which had appeared in the spring water, occasionally used by the patients, the origin of the disease was apparent. Brief notes are given of the eleven cases which occurred, all of them patients, excepting two who were employees, and in all of whom a high temperature developed. Both of the employees' cases were mild. The typhoid patients were removed to the hospital and placed in well ventilated and screened rooms, and when their conditions admitted they were taken out into an open ward and covered with gauze netting. Strict measures were taken in the disinfection of eating utensils and excreta. A high caloric feeding was considered advisable, of which the details are given. The patients were treated with salol, 5 grains every six hours, and 10 drops of dilute hydrochloric acid three times a day, and a tepid sponge bath, also three times a day, followed by an alcohol rub. The effects of typhoid vaccines on sixty-two patients altogether, were observed, and the cases classed as active and inactive. Prolonged bed rest for the typhoid patients was considered advisable. The typhoid vaccine injections caused severer reactions only in the active cases. As regards the effect of the typhoid on the tuberculosis, as observed, the conclusions are that it may cause no detrimental effect in the inactive cases, and, in some, benefit to the active condition may follow. Patients with active tuberculosis may have typhoid fever and recover without any effect on the pulmonary disease, and in this series the tuberculosis did not seem to have any appreciable

effect on the course of the typhoid.—*Effects of Typhoid Fever and Typhoid Vaccine on Pulmonary Tuberculosis, E. E. Clovis & G. E. Mills, J. Am. M. Ass., January 31, 1920, lxxiv, No. 5, 297.*

Differential Diagnosis Between Renal Calculus and Tuberculosis.—Hematuria without pain appears early in tuberculosis; hematuria with pain is constant in calculus. Pyuria without pain appears early in tuberculosis; pyuria with pain appears late in calculus. Pus is present in tuberculosis in excessive amount; in calculus it is minimal in amount. Pain in tuberculosis is diffuse, dull, constant; in calculus it is definite, sharp and intermittent. Chills in tuberculosis are common; in calculus they are rare. There is rise of temperature in tuberculosis, especially in the afternoon; in calculus it is rare. Tubercle bacilli in tuberculosis are sometimes present; in calculus they are absent. The ureter is thickened in tuberculosis, sometimes it is palpable; in calculus it is not palpable.—*Stone in the Kidney and Ureter, from the Standpoint of the Clinical Surgeon, A. J. Ochsner, J. Am. M. Ass., October 11, 1919, lxxiii, No. 15.*

Prognosis in Surgical Renal Tuberculosis.—According to the records of the Mayo Clinic 532 persons were operated on for renal tuberculosis from January 1, 1894 to January 1, 1918. A review of the statistics of these cases shows that renal tuberculosis occurs most frequently between the ages of twenty and forty years (70 per cent); and almost twice as often in the male as in the female. The postoperative mortality in the male patient is somewhat higher than in the female. In children, it occurs more often as a part of general tuberculosis. Evidence of tuberculosis in other tissues may be found in fully 70 per cent of the patients if not in all. The postoperative mortality among patients with coincident lesions is not higher than that of the general average; even multiple lesions, unless they are a part of an acute general infection, do not necessarily render the prognosis more unfavorable. Evidence of healed pulmonary tuberculosis is present in fully one-third of the patients; and the percentage of recovery in these cases is above the average, indicating increased powers of resistance. Coincident active pulmonary tuberculosis was found in approximately 5 per cent of the patients, of whom more than 60 per cent recovered following nephrectomy. Involvement of the genitalia is present in at least 73 per cent of male patients and does not seem to affect the ultimate recovery. The frequency of spontaneous healing of lesions in the prostate and seminal vesicles contraindicates their removal by subsequent operation. Evidence of tuberculosis of the bones and joints was noted in 6 per cent of the cases, of whom one-half showed active lesions. The late mortality was 5 per cent which indicates that such complications may be an index of increased resistance. Spondylitis, usually healed, was present in 5.7 per cent, with a mortality of 12 per cent. Chronic spondylitis does not affect the prognosis; active spondylitis does not offer a favorable prognosis, although it does not contraindicate nephrectomy. Tuberculous adenitis was present in 19 patients (6.4 per cent); the low mortality (10 per cent) indicates heightened resistance. Reduction in hemoglobin does not necessarily affect the prognosis. The mortality with marked bladder involvement is almost twice as high as with slight involvement. The degree of involvement depends on the virulence of the infection rather than the duration of the symptoms. The mortality percentage is markedly influenced by the degree of kidney involvement, increasing in proportion to the extent of the lesion; early lesions have the lowest mortality and pyonephrosis the highest; occluded renal tuberculosis shows relative immunity and low mortality. The duration of preoperative symptoms does not materially affect the late mortality, but bladder symptoms are more likely to clear up when the preoperative duration is short than when it is long. In bilateral renal tuberculosis, recovery or permanent improvement of the remaining kidney will not follow after one kidney has been removed. Operation in these cases is advisable only when there are acute unilateral complications, and then with no hope of eventual recovery. Operative mortality is a negligible factor. Late mortality (five years or less after operation) is approximately 20 per cent; late mortality is much the highest during the first year, decreasing with the length of time after operation. Failure to effect complete cure is approximately 20 per cent. This leaves a prognosis of recovery in 80 per cent and of a complete cure, including cessation of urinary symptoms, in fully 60 per cent.—*Surgical Renal Tuberculosis: The Prognosis, W. F. Braasch, Am. J. M. Sc., January, 1920, clix, No. 1, 8.*

Immunity of Coloradoans.—A conviction held for many years is expressed emphatically in this paper, that most Coloradoans are practically immune to pulmonary tuberculosis. This has been greatly

strengthened by some statistics. Only a very small percentage of deaths from tuberculosis are said to occur among the native Coloradoans.—*Immunity of Coloradoans to Pulmonary Tuberculosis, H. B. Whitney, Col. Med., November, 1919, xvi, No. 11, 268.*

Tuberculosis of the Urinary Apparatus after Fifty.—Lepoutre remarks that Rochet is the only writer he knows of who has called attention to tuberculosis of the urinary apparatus in elderly men. He describes a case of the kind in a man of 58 which proved fatal in little less than a year from the first symptoms. Analysis of some published statistics shows that tuberculosis of the urinary apparatus is not exceptional after 50, and it occurs in about the same proportion in men and in women, but the number of operable cases in men after 50 is exceptionally small. It escapes diagnosis only because physicians do not think of it, as a rule. In 1,530 cases he has compiled from the literature, 44 were in men over 50, and an operation was attempted in only 13 in this group. In the 13 operative cases 7 terminated fatally in one day up to five months; the outcome is not known in 4 cases; one died twenty months later, and only Verhooghen's one patient was still well after an interval of six months. These bad results justify nonoperative treatment.—*De la tuberculose urinaire chez l'homme âge, C. Lepoutre, Presse Med., September 22, 1919, xxvii, No. 53, 535.*

Metabolism of Human and Bovine Tubercle Bacilli.—The authors find distinct differences in the nitrogen metabolism of virulent and avirulent human tubercle bacilli, and also between human and bovine types, as a result of which they offer an explanation of those phenomena of acid and alkaline change in glycerol broth culture which were originally described by Theobald Smith. In a previous series of experiments on rapidly growing, avirulent tubercle bacilli and a number of other acid-fast organisms the authors established the following facts: Such tubercle bacilli produce moderate amounts of ammonia in broth culture, approximately 30 mgm. per 100 cc. on the average, the maximum production being reached about the fourth week in glycerol broth, the reaction becoming progressively acid during this period. From the fourth week on the ammonia content of the broth gradually recedes until at the end of six weeks scarcely half of the maximum amount remains in solution. While the increase in ammonia may be definitely correlated with luxuriance of growth and is in all probability due to deamination of the protein constituents of the medium, the explanation of the recession is less easy. It is coincident with recessive changes in the organisms such as loss in intensity of staining and the appearance of beaded forms. Total nitrogen determinations show a decrease in the nitrogen content of the medium at the height of bacterial development followed by an increase suggesting autolysis of the organisms with liberation of some of the nitrogen in soluble form. A rise and fall of esterase and lipase activity of the bacterial free filtrates of these cultures parallels the rise and fall of ammonia production.

In the recent experiments the metabolism of virulent tubercle bacilli of both human and bovine types was studied. Two virulent human strains were used, 1 mgm. of either of which was sufficient to kill a full grown guinea-pig in three to four weeks on subcutaneous injection. Rabbits were not affected by 10 mgm. The organisms were grown in 250 cc. Erlenmeyer flasks on 100 cc. of 3 per cent glycerol broth, four weeks being required for growth to cover the surface. A large number of inoculated flasks and corresponding number of uninoculated controls were incubated at the same time and determinations were made each week of the titratable acidity to both neutral red and phenophthalein, and of the ammonia and amino acid nitrogen. The lipolytic activity was also estimated. Four bovine cultures were studied in the same way, two of which were very virulent, 1 mgm. being fatal for rabbits. Several milligrams of the other two cultures were required to kill. Rate of growth was inversely proportional to virulence. The noteworthy chemical features of the growth of the human tubercle bacilli were the production of an acid reaction together with a gradual decrease in the ammonia, amino acid, and total nitrogen of the medium up to the point of maximum development of the culture. Later, seventh to eighth week, an increase in ammonia and amino acid nitrogen in solution was noted, presumably due to autolysis of the bacilli. The primary decrease in the ammonia content of the medium followed by a late increase, are in sharp contrast to the conditions noted in avirulent cultures, where an early increase in ammonia occurs, followed by a decrease after several weeks. In bovine cultures a slight but progressive increase in titratable alkalinity was noted. At the same time a steady increase in the ammonia and amino acid content of the medium took place. All these features are the reverse of what seemed to be char-

acteristic of the virulent human strains studied. The explanation offered for these differences in the nitrogen metabolism of human and bovine strains in glycerol broth is as follows: The development of an acid reaction by human bacilli together with minimal deamination, as shown by the decrease in the ammonia content of the medium during the period of growth, suggests that the glycerol is utilized largely for the energy requirements of the bacilli, yielding acid products in its breakdown, but shielding the protein constituents of the medium. That is, the latter are broken down only as their nitrogen is needed for incorporation in bacillary substance, the glycerol sufficing for consumption to produce heat and energy. In the metabolism of bovine bacilli, on the other hand, protein shielding is not in evidence. The development of an alkaline reaction, together with unmistakable evidence of deamination and cleavage of protein to amino acids, indicates that bovine tubercle bacilli cannot or do not ferment glycerol. This appears to be the true explanation of the difference in reaction curve of the two types of organism. The esterase and lipase content of the filtered cultures was practically nil in the virulent strains, both human and bovine, while it increased with growth in the avirulent cultures. The experiments on metabolism have so far not revealed the underlying cause of this.—*The Metabolism of Virulent Human Tubercle Bacilli. (Studies in acid-fast bacteria XI). The Metabolism of Bovine Tubercle Bacilli. (Studies in acid-fast bacteria XII). A. I. Kendall, A. A. Day, and A. W. Walker., J. Inf. Dis., January 1920, xxvi, 45–51 and 77–84. Cf. Studies in acid-fast bacteria I-X, ibid., November, 1914, xv, 417–471.*

Methods for Concentrating and Isolating Tubercle Bacilli.—To the sputum, caseous pus, or moderately cut or minced tissues add a few mils of the sodium hydroxide solution (Sod. hydrox. 70.0; aq. dest. ad 250.0). Mix well and add Rice's bromine solution (bromine 30.0; sod. brom., 30.0; aq. dest. ad 250) in successive small portions until a clear liquid is obtained. The use of heat is not necessary. The liquid is then diluted with distilled water to reduce the specific gravity and is centrifuged at high speed to precipitate the bacilli. These are then washed with two successive portions of distilled water, centrifuging to remove the alkali. The residue is mounted on a microscopic slide in the usual manner, using a trace of albumin to fix on the slide.—*A Convenient Method for Concentrating and Isolating Tubercle Bacilli, H. J. Goeckel, Med. Rec., November 15, 1919, xcvi, No. 20, 804.*

Stain for Tubercle Bacilli.—The acids used to decolorize the bacilli with the usual technic are too powerful and detract from the effect. To avoid this the author uses methylene blue in excess in a solution of 40 cc. lactic acid in 160 cc. distilled water, and adds to this at the time of using four parts of alcohol (95 per cent). This both decolorizes and recolors at the same time, with the finest and most constant results. It has shown up tubercle bacilli in sputum, urine and stools when the Ziehl gave negative findings, and the accuracy of the lactic acid method was confirmed by the course of the cases. The nonacid resisting bacilli can be differentiated more readily, and the whole procedure takes less time than the ordinary technic.—*Sulla colorazione dei bacilli tubercolari col lacto-bleu di metilene alcoolico, A. Gasbarrini, Policlin, July 23, 1919, xxvi, No. 28, 874 (sezione pratica).*

Bacteriology of Tuberculous Abscess.—Demolon found inoculation of guinea pigs the most reliable means to determine the bacillary nature of a cold abscess, as he shows by three typical case reports. The inoculations may prove positive up to the very last traces of the healing abscess. It is evident therefore that the healing of these abscesses is due to some clinical process other than sterilization. Under vigorous disinfectants the pus may give negative findings for a time, but as soon as the disinfectant is stopped, the bacilli may reappear from their lurking places in the deeper tissues. During the entire course of treatment, even with camphorated naphthol, the bacilli seemed to retain the same virulence, judging from the action on the inoculated animals.—*Bacille de Koch et tuberculoses externes, A. Demolon, Paris Méd., September 20, 1919, ix, No. 38, 234.*

Source of Infection and Course of Tuberculosis.—The material studied consisted of 500 cases of tuberculosis in children at the Berlin Charité in 1916, 1917 and 1918. The first question the author attempts to answer is whether or not there is a relation between the course of tuberculosis, and the source of the infection (familial or extra-familial) or the presence of a hereditary taint. Of the 500 cases, in 218 the source of the infection could not be determined, while in 67 cases it was not in the family (extra-familial) and in 215 lay within the family circle. The cases running an acute course (especially miliary tuberculosis, tuberculous meningitis, and the caseous pneumonias) were more frequent in those with extra-familial or unknown sources of infections. On the other

hand, cases in which the source of the infection lay in the immediate family were prone to develop a more chronic or less virulent form of tuberculosis. Of 25 cases of miliary tuberculosis, in 13 (52 per cent) the source of the infection could not be determined. Of 87 cases of tuberculous meningitis in 43 (49.4 per cent) the source of the infection could not be determined, and 33 were from a tuberculous environment. In 54 (62 per cent) there was no hereditary taint. Children in a tuberculous environment contract tuberculosis oftener than in non-tuberculous surroundings, but it would seem as though frequent exposure to tuberculous infection leads to the production of a certain degree of immunity. Hence even in the presence of a hereditary taint, the death rate is lower and the infection shows more of a tendency to the production of milder and more chronic lesions which often result in ultimate cure. The location of the lesion is very important for prognosis. A pulmonary lesion in childhood always has a tendency to dissemination and eventually to cause death. Tuberculous meningitis is always, and tuberculous enteritis almost always, fatal. Tuberculosis of bones and lymph glands is apt to be limited to these structures, and often results in complete recovery. Tuberculous pleurisy also gives a good chance of ultimate recovery—*Die Abhaengigkeit des Tuberkuloseverlaufs beim Kinde von den Infektionsbedingungen der Hereditaeren Belastung und der Lokalisation der Tuberkulose, Helene Eliasberg, Jahrb. f. Kinderhk., 1919, xxxix, Ser. 3, No. 39, 77.*

Westward Migration of Indigent Tuberculous Persons.—It is a common and fallacious belief held by hundreds of tuberculous persons that the climate of Denver is so favorable to the cure of tuberculosis that the mere being there, even if without funds, will bring relief to the sufferers. Our attention has been called by the Denver Anti-Tuberculosis Society to the disastrous results of this belief. It has been estimated by the United States Public Health Service that at least four hundred tuberculous persons go to Denver each year without sufficient money for adequate treatment. They arrive at their destination, often penniless and without having made any inquiries or provisions for their needs, expecting to maintain themselves by some sort of light work. To find such work, however, or work of any kind for a person with active tuberculosis is practically impossible, as the demand for it is always many times greater than the supply. Since Colorado has no state tuberculosis sanatorium and Denver has no such municipal institution, the care of these persons is limited to the following places, which are so over-taxed continuously that it is a long and difficult matter to gain admittance. There are two free Jewish sanatoria with a capacity of one hundred and fifty beds each, which accept a certain proportion of Gentiles. Patients must apply from their place of departure, and await notification before going to Denver. The waiting lists are always long, and it is usually months before an applicant can be admitted. The County Hospital and the County Poor Farm have a combined capacity of fifty-nine beds. Only those persons having at least one year's legal residence in Denver are eligible for admission. There is also a small home for a dozen destitute women, and a small tent colony for indigent tuberculous men, located on the outskirts of the city and maintained by public subscription. The tuberculous person who seeks to regain his health in Denver should have sufficient funds for at least two years' good care. A few weeks or months in a lodging-house, or even in a sanatorium, seldom result in any lasting benefit, and often are merely a waste of time and money. Plenty of good food, rest, fresh air, and medical attention are absolutely necessary for recovery, and must be continued over a sufficient length of time to secure an arrest or a cure. A person without funds can not be provided with these essentials; the resultant anxiety, homesickness, hopelessness, and desperate necessity of working before he is able, especially if he has a dependent family, usually lead to a breakdown far more serious than the original condition. A number of communities in different parts of the country are now making an earnest effort to control tuberculosis among the indigent and those without sufficient funds. It is to be hoped that more states will awaken to their individual responsibilities and will build state sanatoria with capacity to care for all their indigent tuberculous. In the mean time, every effort should be made to dissuade indigent tuberculous persons from undertaking the disastrous journey to Denver; for although a favorable climate may facilitate cure, the patient who is unable to pay for food, rest, and proper care in Denver and can obtain them at home, has a better chance of recovering, if he remain where he is.—*Editorial, Boston M. & S. J., April 15, 1920, clxxxii, 405.*

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Abstracts of Tuberculosis *will be published at intervals as an integral part of the* **American Review of Tuberculosis.** *It will receive separate paging and may, if desired, be bound separately at the completion of the volume.*

The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page.

Corrections: See table, p. 97, June, 1920, Review, Abstract Section.—The numbers and rates given for January, 1920, included all forms of tuberculosis instead of only pulmonary. The number and rate respectively for New York State should have read 993 and 105.6; for New York City, 607 and 116.4; for the State exclusive of New York City, 386 and 92.3; urban, 175 and 85.3; rural, 187 and 88.7.

Prophylaxis of Tuberculosis.—Calmette insists on the importance of some of the more recent acquisitions in our knowledge of tuberculosis, such as that the tuberculous with occult or latent lesions may suddenly begin to eliminate tubercle bacilli in their glandular excretions or their dejecta. This intermittent elimination by these occult carriers is very common, but is seldom recognized. He reiterates further that no person and no animal contracts tuberculosis, no matter how unhygienic the environment, unless virulent tubercle bacilli have been brought into this environment by some human or animal continuous or intermittent spreader of these bacteria. All our efforts therefore should be predominantly directed to ward off this importation of the bacilli, especially frequent importations and on an extensive scale. Every one who reacts to the tuberculin test—even though apparently entirely healthy—is an intermittent spreader of germs, the more dangerous because unsuspected. They are the ones who disseminate contagion even in the remotest region of the world. It will always be difficult to discover these intermittent sowers of bacilli, either human or bovine. But every person or animal reacting positively to the tuberculin test should be regarded with suspicion, and young children and young domestic animals in localities still free from infection should be guarded against them, and against contamination of milk and food, by hands, towels, flies, street and other dust. The reservoirs of virus in open tuberculous cases in man and animals are the source of the massive and frequent contaminations which entail phthisis even in adults. To guard their environment against them requires insight and science on the part of physicians and veterinarians, and training in hygiene for all interested, either because they have to live with the sick or fear loss of their herd.—*Les acquisitions récentes de la medicine expérimentale dont il faudra tenir compte desormais dans nos efforts de lutte antituberculeuse, A. Calmette, Presse Med., December 17, 1919, xxvii, No. 77, 773.*

Pulmonary and Other Forms of Tuberculosis.—A distinction is made between pulmonary tuberculosis and consumption. The former is caused by the tubercle bacil-

lus, and its most characteristic lesion is the tubercle surrounded by fibrous tissue with resulting caseation; consumption involves an actual destruction of the lung tissue with the formation of pus and is caused by other pathogenic organisms in a tuberculous lung. The primary infection with the tubercle bacillus usually occurs in childhood, and the development of pulmonary tuberculosis in later years is due, as a rule, to reinfection from within, when for some reason or other the individual's power of resistance are lowered. But the mixed infections, which added to the tuberculous infection are responsible for consumption, come from without and any conditions favoring the spread of bronchial catarrh will increase the amount of consumption. This possibly explains in part the failure of sanatorium treatment in the English climate to cure many cases of tuberculosis. Village settlements in a warm dry climate would probably be preferable because less favorable to the spread of catarrhal infections. Two other possibilities for the future are the use of tuberculin in childhood to increase resistance to subsequent tuberculous infection, and the use of catarrhal vaccines when patients show symptoms of pulmonary tuberculosis, to prevent the development of consumption. The value of these must first be proved.—*Pulmonary Tuberculosis and Other Forms of Tuberculosis, H. B. Shaw, Lancet, January 24, 1920, 179.*

Latent Tuberculosis. — Investigators have proved that the tubercle bacillus may penetrate the tissues without leaving any trace at the point of entrance and may scatter to various parts of the body and there multiply. During this process and before recognizable tuberculous lesions develop in the body, tuberculo-toxins are being manufactured. The term latent tuberculosis is best applied to this period between infection and the development of lesions sufficient to enable us to recognize tuberculous disease. If the presence of the tubercle bacillus is to be discovered during this period, our search must be directed to the more subtle effects of the poisoning of the body by the toxins of the bacilli. The function of every organ of the body may be disturbed at times. Particularly in growing children and adolescents, failure to gain in weight, poor chest development, enlarged cervical glands, disturbance of endocrine balance and lowered blood pressure are suggestive of tuberculous toxemia. Tuberculin is the best method of testing the presence of a tuberculous infection. When by this means it is determined who are and who are not infected, latent tuberculosis will take on a new meaning, and further examination will reveal that many so called latent cases are actually active cases, or may easily develop active symptoms.—*Latent Tuberculosis, O. W. McMichael, Med. Rec., February 21, 1920, xcvii, 317.*

Classification of Pulmonary Tuberculosis.—Fraenkel modifies Albrecht's classification, so as to divide pulmonary tuberculosis into the following types: (1) acute miliary; (2) caseous pneumonia; (3) subacute disseminated small nodular; (4) nodular-cirrhotic (the chronic confluent nodular disease); *a*, hilum-apical process; *b*, chronic-advancing type; *c*, chronic-stationary type; (5) cirrhotic; (6) basal.—*Beitrag zur Frage der Klassifizierung der Lungentuberkulose, E. Fränkel, Zeitschr. f. Tuberk., December, 1919, xxxi, 266.*

Needs of the Tuberculosis Campaign.—The two chief needs of a successful campaign against tuberculosis are surveys to determine the real extent of the disease in each community, and the adoption of definite standards in diagnosis and treatment. In the education of the public on the subject of tuberculosis, the most useful agencies are the public press, moving pictures, and teaching in the public schools in connection with courses on physiology and hygiene. After-care work in the sanatorium must be developed so that the patient is under supervision for months after his discharge. A public consultation service for physicians to aid them in dealing with tuberculous cases is also necessary; this, too, can be organized by the sanatorium. Tuberculosis dispensaries should be easily accessible. More attention should be given to the treatment of nonpulmonary tuberculosis. The spread of the gospel of right living, the correction of evil industrial housing and living conditions, and not efforts directed solely to the tubercle bacillus or the tuberculous individual are most effective in ridding the world of tuberculosis.—*The Present Needs of the Tuberculosis Campaign, J. B. Hawes, 2nd, Boston M. & S. J., February 12, 1920, clxxxii, 161.*

The War and Tuberculosis.—The war has not added one iota to our positive knowledge of tuberculosis. It has perhaps convinced the public that there is more active tuberculosis than has been supposed, and it has made clearer the lack of proper equipment and methods for fighting the disease. Primarily the war has taught us the need of further research on tuberculosis. It has shown us also that large medical military organizations are not the best means of advancing our knowledge of the disease; but that

we must depend on enthusiastic workers in the hospital wards and laboratories and in the sanatoria and dispensaries, and on observant physicians in private practice.—*What the War has Taught Us of Tuberculosis, S. J. Maher, Med. Rec., January 10, 1920, xcvii, 60.*

Better Provision Urged for Tuberculous Discharged Soldiers.—As a part of its efforts to make better provision for the tuberculous among discharged sodiers, and at the same time to bring about an improvement in the campaign the United States Public Health Service is conducting against tuberculosis, Surgeon-General Hugh H. Cummins sent the following telegram to the American Medical Association during its recent sessions in New Orleans: "I desire to urge more active participation by the general practitioner and by general hospitals in the treatment of tuberculosis. To insure earlier diagnoses, properly train internes and other personnel, popularize treatment in the home climate, provide additional facilities. I earnestly indorse the resolution passed by the National Tuberculosis Association in 1916, recommending that general hospitals should admit tuberculous patients and provide separate wards for that purpose. Sanatoriums and specialists in tuberculosis will always be needed and we should have more of them, but I believe that success in the antituberculosis campaign is largely dependent upon first, convenient facilities for observation and prompt treatment of patients with open tuberculosis and second, in a sharpened perception and higher degree of skill by which the family doctor will make early diagnoses or even forestall the development of clinical tuberculosis in the adult before a definite diagnosis is possible. To provide adequate care for tuberculous ex-service men and others, to protect infants from infection, enlist the aid of the general practitioner, allay phthisiophobia, and improve home treatment of tuberculosis, the opening of general hospitals to this most common of all serious diseases will materially assist."

A Tuberculous Cow.—The carcass of a cow inspected at the slaughter house showed no emaciation, and the meat appeared fairly good. The heart, kidneys, neck, throat, head and brain showed no signs of disease, but all other internal organs were affected with tuberculosis. The lungs showed large nodules; the serosa of the stomach, the spleen and diaphragm were affected. The cow had evidently been milked up to within a couple of months before slaughter and must have furnished a considerable quantity of badly infected milk. This shows the need of better veterinary inspection.—*Note on a Tuberculous Cow, J. E. Scales, Brit. M. J., March 20, 1920, 400.*

Can the Tuberculosis Transmission Rate be Reduced?—The plan of the work done was: (1) to determine the presence or absence of tubercle bacilli on eating utensils after they were used by tuberculous patients; (2) to determine the presence or absence of these organisms on eating utensils after these utensils were washed by the usual hand method in hot water; (3) to determine their presence on the hands of patients, and (4) to determine their presence in the air of tuberculosis wards.

Spoon wash water, spoon rinse water, hand scrapings and air washings were investigated. Since tuberculous sputum passes through the oral cavity on its way from the lungs of the tuberculous to the exterior, this cavity becomes contaminated. Objects that enter the mouths of these patients become contaminated with the specific organism. As eating utensils are the most frequent inanimate objects which come in contact with the mouth, it is to be expected that guinea-pigs injected with the wash water from eating utensils of the tuberculous patient would die from tuberculosis. Thirty-five per cent of animals so injected died from the infection.

But the outstanding feature of this series of experiments is that the percentage of deaths, 25, from the rinse water injections was almost as great as that from the wash water injections. It is believed that the hand washing of the spoons in this series of experiments can be taken as representative of the usual method of washing eating utensils. If this is so, the difference in the percentage of deaths between the animals injected with washings and rinsings indicates that only about 30 per cent of the spoons used by tuberculous patients are rendered free from the organism by the usual hand method of washing.

This group of rinse water injections, with its 25 per cent mortality, demonstrates the facility of tuberculosis transmission and indicates that in families the eating utensils are the *major* avenue of distribution.

The primary infection, then, is not the result of airborne transmission, nor is it in the lung as is generally maintained; but it is salivaborne and in lymphoid tissue. The primary focus might be either in the tonsil or in a mesenteric lymph node. From these primary foci, tubercle bacilli are subsequently passed into the lymph channels and thence to the blood stream. Since the first network of small vessels through which the blood passes is in the lung, the organisms are filtered out,

just as in hookworm infection, and here their multiplication produces a secondary focus. In the lung, the evidence indicates that extension again takes place through lymph channels, resulting in multiple foci. From an epidemiologic standpoint the breaking down of these multiple foci, the liberation of tubercle bacilli, the contamination of saliva, the soiling of eating utensils by saliva, and the use of these without being rendered aseptic by boiling water, result in the introduction of repeated small doses, one or more of which are finally carried through the barrier and involve lymphoid tissue of the newly infected person; thus there is completed the cycle of transmission. It is not the large dose of tubercle bacilli that is usually responsible for infection, but it is the repeated small doses. The author emphasizes that his findings in no way influence the teaching that promiscuous spitting and careless coughing should be heartily discouraged, not only from the standpoint of common decency, but also from that of disease prevention. Just as a 99 per cent removal of organisms from a polluted water supply controlled the intestine-borne infections, so, likewise, will a similar reduction of organisms on eating utensils control the saliva-borne infections. The universal application of the principle of eating utensil asepsis will accomplish more in the control of tuberculosis than will any other single measure of practical application. In the control of tuberculosis, the adoption of the principle of using boiling water as a cleansing and a pasteurizing agent of eating utensils applies especially to the small messing group—the family—and also, but to a less extent, to the public eating place.—*Can the Tuberculosis Transmission Rate be Reduced? J. G. Cumming, J. Am. M. Ass., April 17, 1920, lxxiv, 1072.*

Experimental Pneumectomy.—During the past six years, the authors have removed one lung from each of 23 dogs. Intratracheal anaesthesia with positive pressure was always used in the operation. The lung was removed through an intercostal incision on the left side after ligating the pulmonary arteries and veins, stripping the main bronchus and its branches of all lung tissue, and dividing the naked bronchi. The bronchial stump was then carefully closed. Of the 23 dogs, 10 died, 6 of the deaths being due to an epidemic of distemper. Fluoroscopic examinations of the surviving animals showed that neither immediately after the operation nor in the course of weeks or months did any fluid accumulate in the pleural cavity. Within a few days after the operation the heart moved over toward the empty pleural cavity, and within six or eight weeks the pleural cavity was completely or almost completely filled, chiefly by the dislocation of the heart and remaining lung toward the side operated on, but partially by the flattening of the thoracic wall with attendant scoliosis and the elevation of the diaphragm. The remaining lung increases in size. A number of the dogs were under observation for a year, and when placed with other dogs were, with one exception, as active and healthy as the normal animals.—*Experimental Pneumectomy, G. J. Heuer and G. R. Dunn, Bull. Johns Hopkins Hosp., February, 1920, xxxi, 31.*

Bacterial Invasion of Respiratory Tract.—From studies of pulmonary irritating gases and of influenza pneumonia and from experiments on rabbits, the following conclusions were drawn: The submucosa of the trachea contains a rich plexus of lymphatics, prominent everywhere and devoid of valves. At the bifurcation of the trachea anastomosis occurs with similar plexuses in the bronchi, and this phenomenon is repeated throughout the region of the cartilage-bearing bronchi. At the bifurcation of the trachea, as well as of the bronchi, there is drainage to the lymph glands and anastomosis with periarterial and peribronchial lymphatics. When the lymphatics are injected, the larger portion of the material is diverted at these bifurcations, but continuity of the lymphatic system in the tracheal and bronchial submucosae is demonstrable. Pneumococci introduced by needle puncture through the skin into the lumen of the trachea or by insufflation, provided the insufflating catheter damages the epithelium of the trachea, spread by way of the lymphatics to the lung. The lymphatics of the submucosa of the trachea, then, afford a direct pathway of infection to the lung. Although this lymphatic system provides a pathway for infection, it may also serve as a protective mechanism against pulmonary infection, for the drainage of the submocosa of the trachea and bronchi is largely diverted as the lung is approached to the protecting regional lymph glands.—*An Unrecognized Pathway for Bacterial Invasion of the Respiratory Tract (Illustrated), M. C. Winternitz, G. H. Smith and E. S. Robinson, Bull. Johns Hopkins Hosp., March, 1920, xxxi, 63.*

Diagnosis of Early Pulmonary Tuberculosis.—In the diagnosis of pulmonary tuberculosis it is important to distinguish between arrested and early active cases. A full family history and a careful individual history are important aids. Of the subjective symptoms, gradual loss of flesh, increasing lassitude and inaptitude for work,

slight afternoon and evening pyrexia and digestive disturbances are most suggestive. Of the objective signs on physical examination, the most important are slight impairment of percussion resonance in conjunction with enfeeblement of breath sounds and localized areas of crepitations. All parts of the lung must be examined, not merely the apices. A positive sputum report is of great value, but a negative one is of no value. X-ray examination assists very materially especially in hilum tuberculosis. Lastly the tuberculin test should be made, preferably the hypodermic test with Koch's O. T.—*Points in the Early Diagnosis of Pulmonary Tuberculosis, T. Beattie, Brit. M. J., January 24, 1920, 111.*

Inorganic Salts Necessary for the Growth of the Tubercle Bacillus. Lockemann repeats and is unable to confirm the results of Loewenstein (Biochem. Zeitschr. 1911, xxxi, 142) who grew the tubercle bacillus on a medium containing $(NH_4)_2HPO_4$, 0.6 per cent, glycerol 4 per cent, and KCl, K_2SO_4, or NaCl 0.4 per cent, and stated that Mg, K, Na, S, and Cl were not essential for growth. Lockemann believes that Loewenstein did not use preparations pure enough to assure him of the exclusion of other inorganic salts, and emphasizes the necessity of using not only chemicals of the highest purity but also a nonsoluble glass container for the cultures. In his own experiments he was unable to secure growth of human tubercle bacilli without K and Mg. In a number of trials in which a variety of media were used, containing Na, K, Ca, Mg, NH_4, HPO_4, and HSO_4, as well as glycerol, citric acid, and asparagin as sources of C and N, he obtained excellent growth when K, HPO_4, and Mg were present, but not in their absence. These inorganic ions are then essential in the growth of the tubercle bacillus, while Na, Cl, Ca, and S may be dispensed with.—*Welche Nährstoffe sind für das Wachstum der Tuberkelbazillen unbedingt notwendig? Georg Lockemann, Centralbl. f. Bakteriol., Sept. 27, 1919, lxxxiii, 420.*

Technic for Staining Sputum for Tubercle Bacilli.—The method of staining sputum for tubercle bacilli recommended by the author takes less time than the ordinary method and raises the percentage of positive results by at least 25 per cent. A thick portion of the sputum or several mucopurulent pellets are selected and transferred to the slide; one drop of NaOH is added and the sputum emulsified with the aid of heat into a transparent gelatinous mass, which is spread evenly. The slide is dried in the incubator, then immersed in carbol-fuchsin, warmed to incubator temperature and allowed to remain in the incubator fifteen minutes. It is then washed in equal parts of Esbach solution and water, decolorized with 25 per cent nitric acid until faintly pink, washed in water and alcohol, and counterstained with malachite green (1 part of saturated alcoholic solution in 19 parts of water) for thirty seconds to one minute. Malachite green gives a soft groundwork in strong contrast to the bacilli and materially lessens the labor of search.—*An Improved Technique for the Staining of Sputum for Tubercle Bacilli, H. Distaso, Lancet, January 3, 1920, 19.*

Direct Cultivation of Tubercle Bacilli from the Tissues.—In the direct cultivation of tubercle bacilli from the tissues, the disintegration of tissue and the destruction of contaminating bacilli by antiformin is facilitated by a preliminary trituration of the tissue with quartz sand, continued until the material forms a slightly moist, crumbling mass. After a brief exposure to the antiformin, the material is shaken up with sterile saline solution and centrifugalized three times, and the resulting sediment is used for making cultures. This procedure appears to have no deleterious effects on the bodies of the tubercle bacilli or their vitality. The medium used is the Dorset egg medium modified by the addition of horse heart digested with trypsin for three weeks. The eggs used for the preparation of the media should be as nearly as possible new laid. Growth on this medium is rapid, cultures being visible as a rule in less than a week and copious in less than three weeks. The addition of glycerin to this medium inhibits the growth of bovine strains, and other cultural characteristics of bovine and human strains are well defined.—*On the Direct Cultivation of Tubercle Bacilli from Tissue, G. H. Wilson, Brit. M. J., January 31, 1920, 146.*

Tuberculous Psychoneurosis.—Psychoneurosis in the tuberculous is divided into three distinct groups, the hereditary and that accompanying latent and abortive types of pulmonary tuberculosis, the chronic phthisical group, and the acute advancing phthisical group. The cause of the psychoneuroses is based theoretically on three factors; one is a tuberculo-toxemia causing degeneration of the neuron, another is the rationalistic theory of a reaction of the patient to a change in the patient's environment, and the third the subconscious feeling of organ insufficiency, applying Freud's reasoning except that in the place of sex consciousness he places the consciousness of

organ deficiency. The predominating symptoms of the tuberculous psychoneurosis are egoism, optimism and increased sex impulse. Each of these groupings is described in detail, with references to a very large literature.—*Die tuberkulöse Psychoneurose, G. Ichok, Zeitschr. f. Tuberk., February, 1920, xxxi, 334.*

Right Sero-Pneumothorax with Subsequent Left-Sided Effusion.—A young man of 23 with an artificial right-sided pneumothorax developed an effusion on this side which was left alone for a number of months. Later on he developed pain on the left side, with friction rub, higher temperature and general prostration. Exploratory puncture on the left side revealed nothing, whereas a puncture of the right side, immediately after, yielded 1000 cc. of pneumothorax exudate followed by temporary relief. A few days later the condition became very alarming and this time the signs on the left side were much more definite. An exploratory puncture was made and 2000 cc. of clear serous fluid were removed. Thereupon definite improvement followed and several weeks later the fever disappeared. The treatment was carefully continued and the patient is once more up and about.—*Ein Fall von rechtsseitigem Pneumothorax artificialis mit linksseitiger Pleuritis exsudativa, E. Als, Zeitschr. f. Tuberk., February, 1920, xxxi, 333.*

Pott's Disease in Adults.—Doche found no tenderness on pressure in about 33 per cent of thirty-one cases of caries of vertebrae in the dorsal region, and in 25 per cent of 102 in the lumbar region in his 140 cases of Pott's disease in soldiers. Many of the men had been treated for months and even years for neuralgias of different kinds, gastralgia, kidney and liver colic, sciatica and torticollis, before any one had thought of incriminating the spine. Lateral curvature was evident in thirty of the 140 cases, and two-thirds of the men were unable to bend the trunk forward or sideways, but not one of the total number was able to stretch his spine; hyperextension was absolutely blocked. All were given the regular helio-marine course of treatment at the sanatorium in his charge at Arcachon, and all without fistulas recovered, while the mortality was high among the men with infected fistulas. A tragic feature was that, among the forty-three with fistulas, in some they had been deliberately induced by opening up a closed and cold abscess in the iliac or lumbar region. The strain and privations of the war had reduced the vitality, but notwithstanding this the results of treatment were uniformly good when there was not some grave tuberculous lesion elsewhere or a spontaneous or operative fistula. Immobilization was with a cast in two parts. The front part was removed for the general sun bath; then it was replaced and the patient turned over, and the posterior part of the cast removed for exposure to the sun anew. Thus the sun baths were total while the immobilization was complete throughout. The neuralgic pains were not modified by the heliotherapy, and sometimes they compelled extension. All were kept reclining until six or eight months had elapsed since the last clinical symptoms. The abscesses were punctured; spontaneous resorption was very rare. In the cases with infected fistula, ample drainage and irrigation by the Carrel-Dakin method seem to offer a promise of better results, but experience with this method is too recent for a decisive judgment. —*Considérations cliniques et thérapeutiques sur 140 cases de mal de Pott de l'adulte. Résultats obtenus par la cure hélio-marine, J. Doche, Presse Méd., January 14, 1920, 35.*

Hypothyroidism in the Course of Tuberculosis.—A case showing symptoms of hypothyroidism was studied in a soldier, twenty-four years of age, with signs of disease at the left apex. Treatment was accompanied by an abnormal increase in weight and after about two months by the appearance of a dry papulo-erythematous eruption of the face and a furfuraceous desquamation of the whole body. There was no fever. Treatment with thyroid extract produced rapid cure.—*Apparition d'hypothyroidism dans une évolution tuberculeuse, Th. Stephani, Rev. méd. de la Suisse Rom., February, 1920, xl, 108.*

Nontuberculous Pulmonary and Glandular Infections.—The six cases enumerated—an endocarditis with a degenerative nephritis and general anasarca; bronchiectasis of probable syphilitic origin with an obliterative pleuritis and interstitial pneumonia; a case of bronchiectasis of unknown origin; a pleuropneumonic process and an abscess of the lung, both following tonsillectomy, and one with a foreign body in the pleural cavity—all show marked pulmonary findings of a chronic type in the lower lobes of the lungs. All closely resemble tuberculosis, and all have been called tuberculosis of the moderately advanced or of the far-advanced stages. The chief points of differentiation are: (1) Nontuberculous processes are usually at the bases of the lungs, whereas tuberculosis is more frequently at the apices. (2) Though the pulmonary findings are extensive and of the type of an acute active tuberculous process, the

constitutional symptoms are slight in comparison. (3) Although there often is a large amount of purulent sputum, repeated examinations for tubercle bacilli are negative. (4) At times a definite diagnosis can be made only by prolonged observation, the course of the disease clearing up the difficulty. We should always bear in mind that tuberculosis may be present despite negative evidence, yet it is more urgent to go to the other extreme and refrain from stamping the patient as tuberculous without positive evidence. While hemorrhage or blood-spitting is a reasonably sure sign of tuberculosis, we should always bear in mind that it is frequently caused by high blood pressure and arteriosclerosis, mitral stenosis, bronchiectasis, and malignant tumor. The laboratory and X-ray examinations are valuable aids in clearing up some cases. Two cases admitted as tuberculous adenitis turned out to be Hodgkin's disease.—*Nontuberculous Pulmonary and Glandular Infections, Admitted to the Municipal Tuberculosis Sanatorium, A. J. Hruby, Bull. City of Chicago Mun. Tuberc. San., November, 1919, i, no. 10.*

Influenza and Pulmonary Tuberculosis.—Dorn, after citing the experiences of numerous other investigators in regard to the effect of influenza upon pulmonary tuberculosis, gives statistics of the epidemic of influenza at the Wilhelmsheim Sanatorium in the summer of 1918. There were then 139 army patients, 39 civilian patients and 48 employees. In the three weeks period between the end of June and middle of July, 1918, 85 army patients, 20 civilian patients and 12 employees were taken sick with influenza. Six of the employees were tuberculous. So that, of a total of 184 cases of pulmonary tuberculosis, 111 had influenza. Of these 111, according to the Turban-Gerhardt classification, there were 27 in the first stage, of whom 2 had positive sputum and one tuberculous laryngitis; 17 in the second stage, of whom 5 had positive sputum, one a pneumothorax, one a perirectal abscess and one testicular tuberculosis; and 54 were in the third stage, of whom 52 had positive sputum, 7 had tuberculous laryngitis, one a perirectal abscess, one a knee tuberculosis and 6 pneumothorax. It is seen that most of the tuberculous cases were severe with complications. In only two did the influenza have any lasting untoward effect. In three cases there was a temporary flare-up. In the fall of 1918 there was a second epidemic in the surrounding country, and the population of the sanatorium remained practically the same as in the summer. There were only two cases that developed influenza, one a healthy employee seventeen years of age who died of influenza, the other a French soldier who was brought in ill and died. None of the patients became ill. Dorn feels from his experience that the tuberculous are more resistant to influenza, because their long illness has probably given rise to more numerous antibody formations.—*Grippe und Lungentuberkulose, E. Dorn, Zeitschr. f. Tuberk., December, 1919, xxxi, 257.*

Influenza and Tuberculosis.—The author puts the following questions: (1) How does the grippe influence an already existing pulmonary tuberculosis? (2) Has it caused fresh outbreaks of tuberculosis or made manifest latent lesions? (3) What nontuberculous chronic pulmonary lesions are known to be caused by influenza? The answer, based on his own observations and a study of the literature is as follows: (1) The influence of the grippe depends on the extent of the tuberculosis. Incipient apical lesions and benign cirrhotic processes are usually not influenced; grave cases usually change for the worse. In one case of apical tuberculosis a miliary dissemination of tubercles took place coincident with a grippe pneumonia. (2) A latent hitherto undiscovered tuberculosis may become manifest after influenza. In the author's cases these lesions were centrally located. This is due to grippal swelling of the mediastinal lymph nodes which continues for a time after the attack and furnishes a locus minoris resistentiae for the implantation or spread of tuberculosis. This is in marked analogy to measles. (3) A case of chronic pneumonia was observed to follow grippe.—*Ueber die Beziehungen zwischen Grippe und Tuberkulose, mit besonderer Beruecksichtigung der Entstehung zentraler Lungentuberkulose nach Grippe, J. E. Keyser-Petersen, Münch. med. Wchnschr., October 31, 1919, lxvi, 1261.*

Sanatorium or Home Treatment in Relation to Hardening.—Köhler divides life into three periods: the first, from infancy to thirty years; the second, from thirty to thirty-five years, being a transitional period; and the third, from thirty-five years upward, the period of katastasis. During the first period, exercise, cold baths and an outdoor regimen stimulate the production of body heat actively. In the last period, from thirty-five years on, the heat must be supplied externally, by hot bathing, application of heat, warmer clothing, etc., and the patient should not be exposed to the rigors of extreme cold, sudden changes, etc. In the transitional period, from thirty to thirty-five years, great care must be taken to determine whether the body reacts to the

stimuli of the first period with heat production and hardening, or whether lowered vitality results. In the event of any disease which lowers the vitality, such as tuberculosis, the period of katastasis may be advanced and the patient must be treated accordingly. Köhler calls the first period the "exercise" period, and believes that people who respond to the sudden changes of temperature and the exposure are really undergoing a form of exercise, and that those who do not react favorably should be put on a therapy which excludes rigors and changes in temperature, exposure, cold bathing, etc., supplies heat externally and favors an indoor regimen rather than outdoor during cold weather.—*Zur Heilstättenbehandlung und häuslichen Behandlung der Lungentuberkulose sowie zur Theorie und Praxis der Abhärtung, F. Köhler, Zeitschr. f. Tuberk., February, 1920, xxxi, no. 6, 321.*

The Village Settlement and Workshop Treatment of Tuberculosis.—Sanatorium treatment of the tuberculous has failed, to some extent at any rate. Such treatment seldom cures but rather arrests the disease sufficiently for the subject to go out into the world to fight the battle of life, more especially if he is a manual worker. One great object of sanatorium treatment used to be to accustom the patient to agricultural pursuits, gardening, and so on, the argument being that open air life was the only one suited to the consumptive. Some obvious facts were overlooked when propounding and putting into practice this theory. In the first place, agricultural labor is a skilled form of labor, and a hard and trying form of work with long hours. The adult consumptive is never likely to learn the work sufficiently well to earn decent wages, and although the work is done in the open air the conditions, atmospheric and otherwise, under which it is performed are much too severe a tax on a constitution the vitality of which has been sapped by tuberculosis. The individual in such a position is not able to earn enough to feed himself as his condition requires, and if he has a wife and family the state of affairs is desperate. However, there is no need to elaborate this point, as it is now well understood that as a rule the consumptive is not fitted for agricultural labor or even for gardening. If he has been an industrial worker or an artisan, he had better go back to his old trade or craft unless it is manifestly contraindicated by the unhealthiness of the occupation. In any event, in nine cases out of ten the tuberculous person is more likely to retain a fair measure of health working indoors at a trade he knows than as an unskilled outdoor worker earning starvation wages and exposed to the vicissitudes of a changeable climate. In certain parts of this country an out of door life can perhaps be followed by the consumptive with benefit to his health and a fair living wage, but generally speaking, and certainly in Great Britain, out of doors agricultural labor has been tried for the consumptive and found wanting.

But another difficulty arises. How are those partially disabled by tuberculosis of the lungs to find employment in factories or workshops? They cannot do a man's work, cannot keep regular hours of work, and in addition the ordinary normal workman objects to working side by side with the consumptive. A scheme has been proposed and put into practice in this country and in Great Britain whereby colonies and industrial centers are established for those suffering from pulmonary tuberculosis, and the plan seems to have met with success. Of course all is not plain sailing for such institutions, but as adjuncts to the sanatorium they should help to solve the problem of the consumptive, possibly with a wife and family, who is able to work, but only under suitable conditions. The colony is at the same time agricultural and industrial and should provide the means for rendering many consumptives self-supporting and self-respecting. It must be borne in mind that in the case of the tuberculous the mind has a great influence over the health and that if the sufferer is fairly contented, this mental outlook will react favorably on the physical conditions. The colony system is now on trial and extension depends upon how it stands the test. The March issue of *Tubercle*, the new British monthly dealing with tuberculosis, points out that many men will not care to abandon their urban homes and plant themselves and their families in an unknown, even though a more salubrious environment. This sounds true, and means must be found to render the colonies attractive or they must be devised on another plan. For the sake of the community at large, some such scheme should be established, for it is not only a question of the consumptive himself but of the race.—*Editorial Note, N. York M. J., April 24, 1920, cxi, 732.*

Deaths and Death Rates from Pulmonary Tuberculosis in New York City and State.—The following tables, showing the deaths and death rates from pulmonary tuberculosis for New York City and State, for February, March and April, during the years 1913 to 1920, inclusive, and graphs for the years 1913 to 1920, to April, 1920, are taken from the *Monthly Vital Statistics Review, New York State Department of Health, April, May and June, 1920, New Series, vol. i, nos, 2, 3 and 4.*

Pulmonary tuberculosis: deaths and death rates, New York State and large subdivisions, February, 1913 to 1920*

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
February average	1913–17	1,226	158.0	778	185.5	448	125.8	233	134.9	215	117.3		
February	1913	1,201	160.9	776	194.5	425	122.4	228	134.9	197	111.1		
February	1914	1,210	159.0	764	180.8	446	126.8	226	131.0	220	123.8		
February	1915	1,202	154.9	793	189.1	409	114.9	204	118.1	205	111.9		
February	1916	1,252	153.4	752	169.4	500	134.4	277	152.9	223	116.8		
February	1917	1,265	157.1	803	182.4	462	126.7	231	129.8	231	123.7		
February	1918	1,287	157.0	786	174.5	501	135.8	239	131.8	209	111.3	53	
February	1919	1,216	145.8	757	164.3	459	123.0	190	102.9	215	113.9	54	
February	**1920**	**1,222**	**139.2**	**701**	**143.8**	**521**	**133.4**	**226**	**116.7**	**236**	**119.8**	**59**	

* Deaths per 100,000 population per annum.
Data from New York State Health Department Annual Reports and Monthly Bulletins, or specially computed.

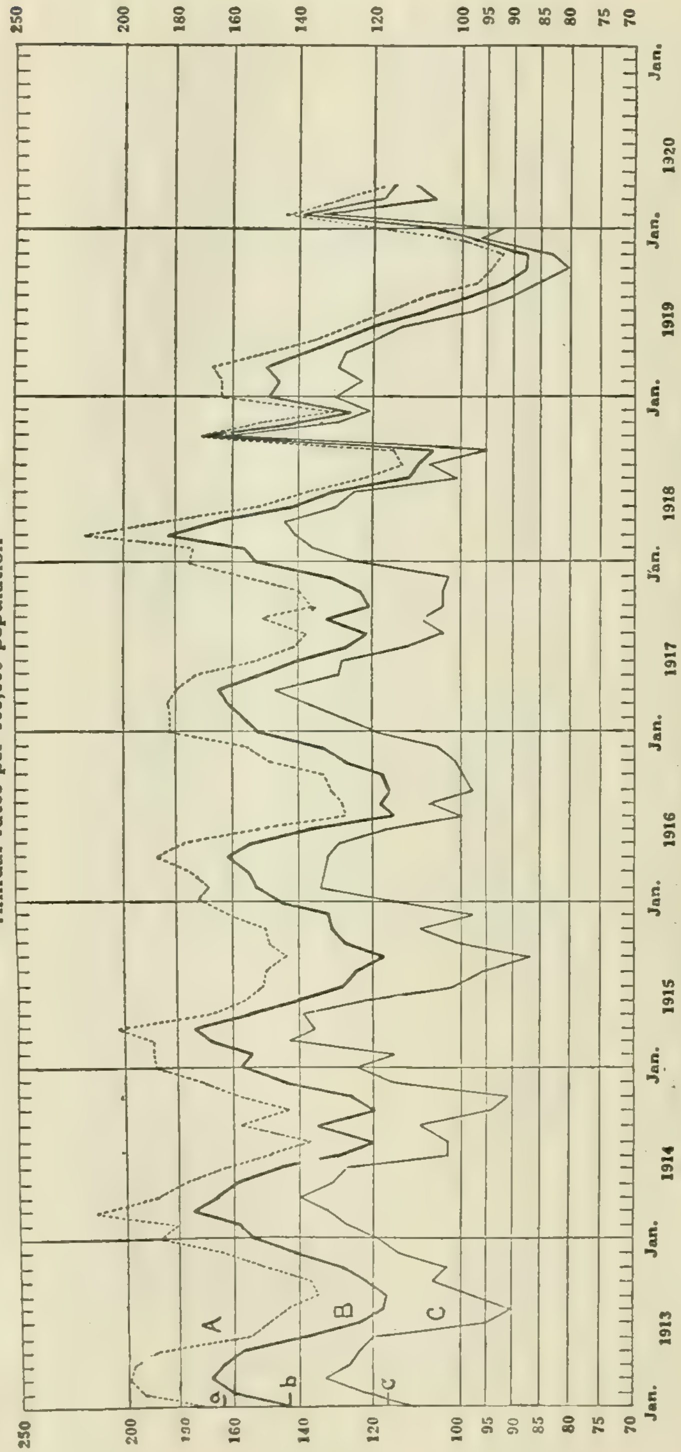
Pulmonary tuberculosis: deaths and death rates, New York State and large subdivisions, March, 1913 to 1920

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
March average	1913–17	1,422	165.7	888	191.2	534	135.5	288	150.6	246	121.2		
March	1913	1,395	168.8	882	199.8	513	133.4	262	140.0	251	127.9		
March	1914	1,473	174.8	960	212.5	513	132.1	275	143.9	238	121.0		
March	1915	1,442	167.8	877	188.9	565	143.3	313	168.7	252	124.2		
March	1916	1,359	155.7	831	175.0	528	132.7	306	158.0	222	108.7		
March	1917	1,441	161.7	890	183.1	551	136.8	285	144.7	266	128.7		
March	1918	1,658	183.2	1,083	217.6	575	141.0	285	142.0	233	112.1	57	
March	1919	1,383	149.8	852	167.3	531	128.8	246	120.4	226	108.2	59	
March	**1920**	**1,107**	**118.1**	**665**	**127.7**	**442**	**106.0**	**183**	**88.5**	**220**	**104.6**	**39**	

Pulmonary tuberculosis: deaths and death rates; New York State and large subdivisions, April, 1913 to 1920

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
April Average	1913–17	1,397	168.1	859	191.1	537	140.8	277	149.7	261	132.9		
April	1913	1,357	169.8	847	198.2	510	137.0	256	141.4	254	133.7		
April	1914	1,389	170.3	822	188.0	567	150.9	273	147.7	294	154.4		
April	1915	1,442	173.5	923	205.4	519	136.1	302	163.2	217	110.5		
April	1916	1,370	162.2	859	187.0	511	132.7	258	137.6	253	128.1		
April	1917	1,425	165.3	846	179.9	579	148.6	294	154.2	285	142.5		
April	1918	1,445	165.0	876	182.0	569	144.4	272	140.1	253	125.8	44	
April	1919	1,236	138.3	728	147.9	508	127.4	223	112.7	228	112.8	57	
April	**1920**	**1,046**	**115.1**	**591**	**117.1**	**455**	**112.5**	**176**	**87.8**	**225**	**110.3**	**54**	

DEATH RATE FROM PULMONARY TUBERCULOSIS: NEW YORK STATE, NEW YORK CITY, AND STATE EXCLUSIVE OF NEW YORK CITY, BY MONTHS, 1913 TO 1920.
Annual rates per 100,000 population

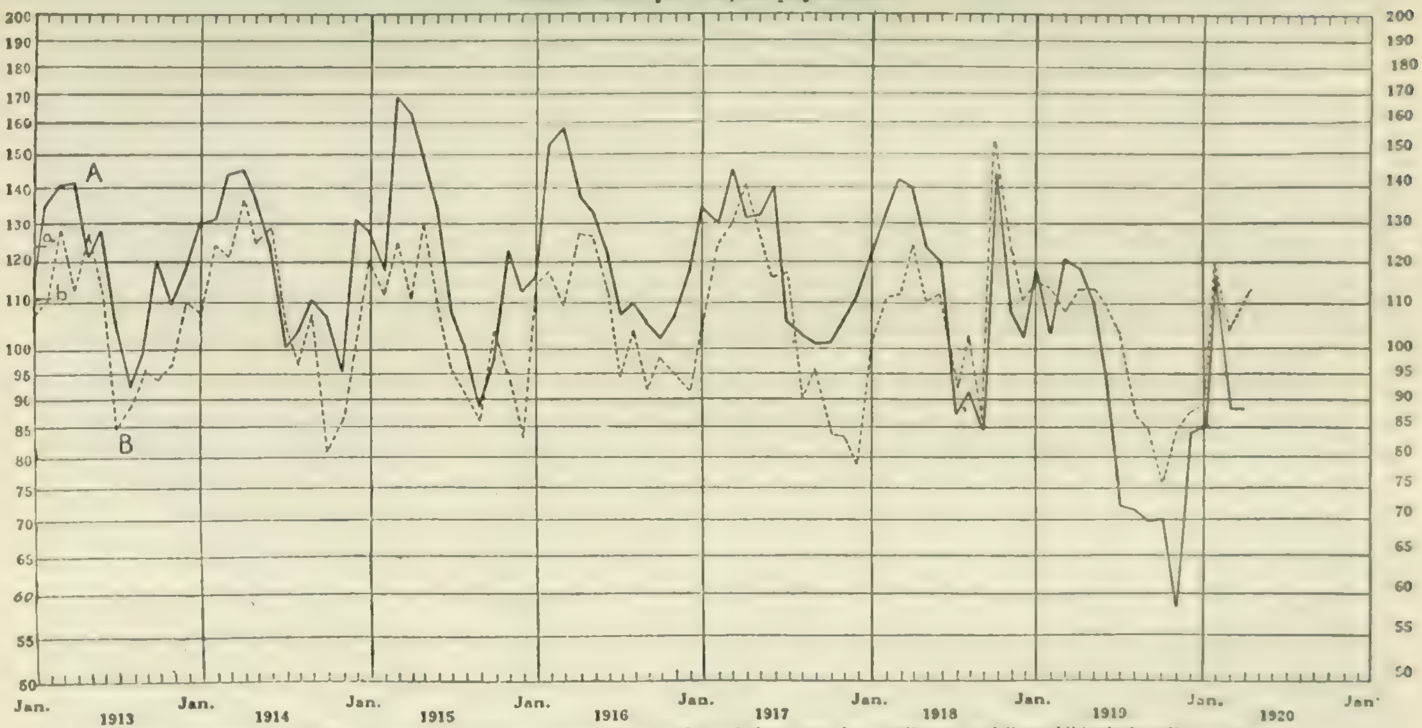


A, New York City; B, New York State; C, State exclusive of New York City

Average annual rates: 1913–1917, a, 164.1, New York City; b, 142.6, New York State; c, 117.1, State exclusive of New York City

DEATH RATE FROM PULMONARY TUBERCULOSIS: NEW YORK STATE (EXCLUSIVE OF NEW YORK CITY), URBAN AND RURAL AREAS* BY MONTHS, 1913 TO 1920

Annual rates per 100,000 population



A, Urban; B, Rural. *"Urban" includes all cities (except New York) and three very large villages, and "rural" includes all remaining districts except institutional; see tables 9-10. Average annual rates, 1913-1917: a, 123.9, urban; b, 110.8, rural

Treatment of Tuberculous Osteo-Arthritis.—In a diseased joint there is venous stasis, diminished flow of arterial blood, extravasation of lymph, sluggishness in metabolism, malposition through reflex muscular contraction, rarefying osteitis, all assisting the formation of granulations. In treatment, tuberculin, rest, and heliotherapy have given good results. Tuberculin increases the patient's resistance; while rest, especially continued extension, and heliotherapy improve the circulation, favor the reabsorption of the extravasated products and overcome the contraction. The bone graft, as used by the author, hastens the process of repair by producing condensing osteitis in the surrounding area. In placing the graft, the tuberculous tissue is not touched; the graft is placed so as to extend from the diaphysis to the epiphysis without touching the articular cavity. To produce a rapid deviation of the blood current, two lateral grafts are placed in the cellular subcutaneous tissue. While the grafts are growing, extension by means of bandages and weights is maintained for three months; after that time the patient can get up wearing light plaster bandages which keep the joint immobile. The course of the disease is studied by the roentgen ray which shows the clearing up of the rarefying osteitis, and by palpation which shows when the tenderness disappears. The subcutaneous lateral grafts are then removed, and within ten or twelve days after this slight operation, the patient is turned over to a masseur to bring back mobility to the joint. Heliotherapy is also used. Improvement is noted in the general condition in the first days following the intervention. It is especially in cases of accentuated tuberculous cachexia that operation is urgent.—*Treatment of Tuberculous Osteo-Arthritis by Bone Grafts, C. R. Lavalle, Surg. Gynec. and Obstet., March, 1920, xxx, 239.*

Heliotherapy.—After referring to the work of others, and especially Rollier, with heliotherapy in bone and gland tuberculosis, the author reports six cases of pulmonary tuberculosis treated by Rollier's method of gradual exposure to sunlight. All of the patients were males ranging in age from fifteen to sixty-five years; all were active advanced or second stage cases with tubercle bacilli in the sputa. The treatment was begun early in July and continued until the end of October. Exposures were made only on 107 days, owing to the many days of rains and showers. Determinations of blood pressure, blood counts, and estimations of hemoglobin were made at first every few days, later every week. Patients were weighed weekly, and temperature, pulse and respiration noted daily at the beginning and ending of the treatment. Frequent notes were made as to cough, amount of sputum, appetite, sleep, and condition of the bowels, and results of sputum examinations. Of the six patients, two died, and three became arrested and have returned to work. One patient left the sanatorium as an arrested case but has not been traced for two years. Of the two who died, one left the sanatorium improved but died eighteen months later; the other had a greatly hypertrophied heart, although his death was probably due to tuberculosis. In all the cases the heliotherapy lessened the sputum, improved appetite and sleep; in five cases improved the cough; in two improved the temperature; in four, slowed the pulse rate; four cases (two of them among the arrested cases) lost weight, an average of 2¾ pounds; two gained weight, an average of 7½ pounds. Observations of blood pressure, red and white blood counts, and amount of hemoglobin showed no definite relation between these conditions and a gain or loss in general or lung conditions. In addition, several acute cases of bone and gland tuberculosis in children have recently been treated by the Rollier method for a few weeks, and the results have demonstrated its value. Sunlight properly applied is our best therapeutic agent in the treatment of bone and gland tuberculosis. Although it is most successfully applied in the mountains or at ocean beaches, it also gives good results inland and on the lowlands. The results in the small number of cases of pulmonary tuberculosis treated indicate that it may be of more value in this form of the disease than has been supposed.—*Concerning Heliotherapy in Pulmonary Tuberculosis, J. B. Dinnan, Med., Rec., January 10, 1920, 62.*

Mishaps with Induced Pneumothorax.—Instances of disagreeable by-effects with therapeutic pneumothorax are not always published. The physician should not be too timid nor over-confident in applying the procedure, relying too exclusively on the manometer. In the writer's extensive experience there have been several cases in which hemoptysis or subpleural and subcutaneous emphysema developed, four of secondary valve formation, and one of gas embolism. Faulty technic was responsible in this latter case; the young man had long been returning weekly for insufflation of 200 or 300 cc. of oxygen and was doing finely, having gained 10 pounds in weight and the fever having disappeared. The needle was felt as having traversed the pleura, but the manometer did not waver. Instead of wait-

ing for the usual fluctuations, the insufflation was started. The patient complained at once of intense precordial pain and numbness in his arm. The needle was withdrawn, but the young man became unconscious after some convulsive movements, with complete arrest of the heart action and breathing. Under artificial respiration, injection of camphorated oil and inhalation of oxygen he promptly revived but seemed dazed. This and facial paralysis persisted till night, and there was some vomiting. But all was normal the next day and he had no remembrance of the mishap. The lesson from it is that the gas must not be pumped in before the manometer gives the signal. If a little is allowed to enter, it should merely flow in gently. The whole storm passed over in three minutes; probably the fact that oxygen was the gas being used had a great influence on the promptness of the recovery.

The symptoms from secondary valve formation are those of progressive suffocation, an opening allowing the gas to pass, but a valve shutting off its return. Intense pain at the site of the insufflation and progressive dyspnea half an hour to two hours afterward compelled puncture to release the gas, unless relief was obtained by a spontaneous subcutaneous emphysema. The pressure had increased from 0 to 20 in one of these cases, and the heart was much hampered. The symptoms kept recurring through three days in this case. In all of this group of four the pulmonary lesions were grave and of long standing; the traction on fibrous bands evidently tore out a piece from the parenchyma of the lung during coughing. Hemoptysis was due to pricking a blood vessel, or to activation of the focus in the other lung from traction by bands, or to inadequate compression. In one case described, severe hemoptysis followed insufflation of small amounts of gas, 300 or 500 cc., but it ceased when the amount was increased, and marked improvement followed. —*Accidentes por neumotorax, A. Cetrángolo, Seman. Med., November 13, 1919, xxvi, 603.*

Chemistry and the Laws of Immunity in the Treatment of Tuberculosis.—The tubercle bacillus is protected by waxy substances, consisting chiefly of unsaturated highly complex alcohols and equal quantities of phosphatides with which they form a colloidal complex, which in turn exists in close union, probably chemical, with the protoplasmic substances of the tubercle bacillus. Saponification breaks up this complex without destroying important immunizing substances. Repeated experiments proved that esterification of the fatty acids with ethyl alcohol forms a valuable immunizing substance; and esterification of the higher alcohols with salicylic, benzoic, acetic, or other suitable acids establishes a new side-chain group which enhances the reactivity between the antigens themselves and the receptors of the tissue cells, so that absorption of these alcoholic esters when injected even in doses of 3 to 5 cc. takes place in a few days and specific wax-digestion-ferments form in sufficient concentration to split the protective waxes from the tubercle bacillus with its resulting disorganization and destruction. On these principles an immunizing substance, given the name of mycoleum, was produced, which is essentially a physical mixture of the combined esters of the higher alcohols with the ethyl esters of the fatty acids in the same proportion as they originally exist in the wax of the tubercle bacillus, free from lipoids, proteids, and other impurities. This substance was used with success in the treatment of all forms of tuberculosis, except the acute miliary type of the disease. Caseation is largely done away with and improvement is seen even in advanced stages of the disease. In the treatment of many hundreds of cases the death-rate has been less than two per cent five years after treatment, including all forms and stages of the disease. The rules for treatment are similar to those for syphilis—intensive at first with ever widening intervals between treatments.—*Coördination of the Principles of Chemistry with the Laws of Immunity in the Treatment of Tuberculosis, B. S. Paschall, N. York M. J., January 31, 1920, cxi, 184.*

Genito-Urinary Tuberculosis Treated with Tuberculin.—The author reports 8 cases of genito-urinary tuberculosis and states that about 40 other cases were treated at All Saints Hospital. All showed marked improvement. Contraindications to tuberculin are continued fever, albuminuria and epilepsy. Early cystoscopic examination and testing with tuberculin should be done in every suspicious case. Treatment should be begun when the tuberculin test is positive, whether tubercle bacilli are found in the urine or not. While the best results are obtained in the earlier stages of the disease, treatment should be given at any stage. The tuberculin injections are given twice a week, in increasing doses. The doses are increased until a reaction is obtained. A rise of temperature is almost invariably a prelude to improvement. The first course of treatment should be carried out from six months to a year; a second or third course may be required at varying intervals. Different preparations of tuberculin may be used to advantage.—*Genito-Urinary Tuberculosis Treated with Massive Doses of Tuberculin, R. Creasy, Lancet, March 6, 1920, 542.*

Tuberculin in Bone and Joint Tuberculosis.—From their experience with tuberculin in bone and joint tuberculosis the authors conclude that the use of tuberculin in these cases in conjunction with proper orthopedic care cuts down the time required to produce a cure from 50 to 75 per cent and makes the cure more permanent. In pus cases tuberculin should be used in conjunction with bismuth paste and suitable vaccines. A few months of this combined treatment usually stops the discharge. No set rules can be given for its administration in all cases; the individual patient and his reaction to the treatment must be studied. A tuberculin reaction should not occur; but if it does, the dosage is reduced to one-tenth the amount. The dilutions most frequently used were 1 in 100,000 and 1 in 10,000. Several courses of treatment may be given at short intervals.—*Tuberculin in Bone and Joint Tuberculosis, S. A. Twinch and Alfred Stahl, J. Orthop. Surg., March, 1920, xviii, 151.*

The Chaulmoogric Acid Series in Leprosy and Tuberculosis.—A series of experiments led to the conclusion that the bactericidal active substances of chaulmoogric oil are the fatty acids of the chaulmoogric series, and the bactericidal activity of these acids is specific for the acid fast group of bacteria and inactive against other organisms. This specific bactericidal activity is a function of the carbon ring structure of the molecule of the chaulmoogric acid series which so far as is known is found only in chaulmoogric oil and in oils of certain plants closely related to the *Taraktogenos kurzii.* The fatty acids of cod liver oil, the salts of which constitute the sodium morrhuate advised by Rogers for the treatment of tuberculosis, do not possess this specific power. This bactericidal activity of the chaulmoogric acids, together with the clinical results obtained in leprosy, furnish theoretical grounds for the use of the chaulmoograte in the treatment of tuberculosis. Further experiments are necessary to determine their practical value.—*Chemotherapeutics of the Chaulmoogric Acid Series and Other Fatty Acids in Leprosy and Tuberculosis, E. L. Walker and M. A. Sweeney, J. Infect. Dis., March, 1920, xxvi, 238.*

Inhalation Treatment.—For many years Robinson has been using and recommending a perforated zinc inhaler, the sponge of which is saturated with beechwood creosote, spirits of chloroform and alcohol, equal parts. The patient breathes naturally and without effort and uses the mask at first only a few minutes and gradually almost all the time. The mixture must be renewed whenever the odor of creosote becomes less appreciable. The urine must be watched and if a trace of albumin appears the inhalations should be somewhat restricted. Creosote can be given in addition by mouth. When the cough is very severe, pure chloroform may be used for a while in place of the spirits but the inhalations should not be prolonged and the effect carefully watched. Creosote properly used is the only drug that has a real value in pulmonary tuberculosis.—*The Inhalation Treatment of Pulmonary Tuberculosis, B. Robinson, Med. Rec., January 24, 1920, xcvii, 123.*

Prognosis in Pulmonary Tuberculosis.—Prognosis in pulmonary tuberculosis depends of course upon the stage of disease at which treatment is begun, and upon the presence or absence of complications, but also very largely upon the patient's own attitude and his willingness to follow the proper course of treatment with absolute faithfulness. Hence it is very important that the physician should know how to talk to the tuberculous patient and to explain to him the reason for, and the importance of, each detail of treatment. The need of rest, fresh air, proper food and a careful regulation of all the habits of life should be emphasized. The patient should be told that it is not necessary for him to go to another climate, or even to go away from home at all, if he will make his home a sanatorium with the physician as director. Regular examinations should be made at certain intervals, and evidences of improvement carefully noted and pointed out to the patient. Gain in weight, lessened cough, lowered temperature, better color and better appetite—all indicate a favorable prognosis. The Arneth nuclear count is also of value in so far as a constant increase is favorable. If physicians will take time to discuss things sympathetically with the patient and encourage him in carrying out the necessary treatment thoroughly and for a sufficient length of time, the prognosis will be very noticeably and favorably changed.—*Prognosis in Pulmonary Tuberculosis, A. Henry, Med. Rec., February 14, 1920, xcvii, 272.*

Care of Tuberculous Children.—Sandy Point Branch, Hayling Island, England, was chosen as an ideal place for surgical tuberculosis in children on account of its abundant sunshine, extensive shore with considerable tidal excursions, sandy soil, slight or moderate rainfall, lack of trees, clear atmosphere free from dust, hills protecting against cold winds and rain, bracing climate, beach adequate for unrestricted

use of patients. Patients who are toxic and cachectic, who have chronically infected sinuses or cervical adenitis, and convalescents do well in such a place. Children are instructed in various subjects. They sleep on open verandas, on mattresses which are electrically heated. This is the best and most labor-saving method of keeping the patients uniformly warm. In the Treloar Cripples' Hospital they have a follow-up system for discharged patients. Provision is made for patients who need further treatment after discharge from the hospital, by sending them to various sanatoriums. A postgraduate course for those interested in surgical tuberculosis is conducted at Alton Hospital. Recently chemotherapeutic substances such as copper, iodine, chlorine and brass compounds have been employed for external tuberculosis and lupus. There is plenty of sunshine in England for a great part of the year to make heliotherapy practical. Sunshine acts directly on superficial lesions by its bactericidal power and indirectly by inducing favorable constitutional reactions. The beneficial influence on deep seated lesions depends on the amount of skin pigmentation. Pigmenting power is in direct ratio with resisting power and this has a prognostic value. The effect of the sun cure is largely psychological.—*Care of Tuberculous Children. Some Recent Innovations and Methods of Treatment at the Treloar Cripples' Hospital, Alton. H. Gauvain, Brit. J. Tuberc., April,* 1920, *xiv, 4.*

Climate in Tuberculosis.—Guiding principles in the matter of climate can be evolved only upon the basis of knowledge of the personal factor, in the light of which domestic and terrestrial climates derive their significance. The personal climate is within the person's own clothes. Peculiarities of clothing, personal cleanliness and skin hygiene will do much to modify terrestrial and domestic climate. Foremost in the personal climate is the skin, since through it the greater part of the effect of climate is transmitted to the organism; hence a proper training of the skin in infancy and childhood constitutes the important part of the climatic prophylaxis in tuberculosis. The thing to avoid for the skin is the dull, uniform, nonstimulating environment. The climate with considerable variations of temperature of day and night, of sun and shade, of indoor and outdoor air, prevents a slothful functioning of the dermal organ. Also the radiant quality of the environmental temperature is most significant. The radiant heat of an open fire facilitates the bearing of low indoor temperatures, and reproduces for the skin the quality of the Alpine climate. The advantages of the external physical conditions of the home or the place of work come under the domestic climate, and are of paramount importance since but few persons have the opportunity of changing the terrestrial climate. Ventilation, public and private, fresh air, and cool air are advantages available in the domestic surroundings. A higher cooling power not only increases metabolism during the exposure, but it also raises basal metabolism. Largely in this lies the benefit of open air treatment of children and consumptives. The effect upon man made by the terrestrial climate is determined by the demand it makes upon the patient's production of heat. Hubbard has reduced the value of the various factors in climate, such as temperature, movement of air, humidity, atmospheric pressure, insolation, etc., to this common standard. Of all these factors, altitude above the sea level lends itself to a precise estimation of its effect in terms of increase of the red blood cells. These increase numerically with ascent to any altitude short of one which causes mountain sickness. Although the altitude polycythaemia is no longer considered an essential of mountain therapy (the cell increase being merely a phsyiological adaptatation to compensate for the rarefaction of the atmosphere), nevertheless the actual increase of this blood tissue may well produce the remarkable stimulating effect of the change from sea to mountain level. This corpuscular increase persists for some time after the descent to sea level and offers a reasonable explanation for the feeling of well being which follows a holiday spent wisely in the mountains. Every individual has his own optimum altitude at which to live All sorts of pains may disappear at certain altitudes in certain persons. An indirect effect of altitude rarefaction of the air is increased insolation. The shorter light waves at the violet end of the spectrum being poorly absorbed by the thin air, cause a pigmentation of the skin. This is of therapeutic value. Prognosis is bad in tuberculous patients who fail to tan. The pigmented cells very likely turn to some useful purpose the energy of the ultraviolet rays. Bernard's and Rollier's treatments are based upon the application of this principle. A pigmented skin furthers adaptation to varying climatic influences. The bulk of evidence supports the view that no climate possesses therapeutic specificity. The choice of climate is to be determined rather by the response of the patient than by the assumed influence on his disease. The traditional belief that a hemorrhagic tendency contraindicates high altitude is based upon the unfounded opinion that

blood-pressure rises with elevation. However, there cannot be any doubt of the striking influence of altitude upon asthma, especially in children. Finally, the mental and emotional quality of the patient is to be reckoned with in the choice of climate. The view held by Celsus that the worst climate for the patient is that which made him ill, and the very opposite view held by the modern medical economist, that the cure is best made in the climate where the patient has to live after his cure, are conciliated by the above considerations.—*Climate in Tuberculosis, E. Morland, J. State Med., May, 1920, xxviii, 129.*

Antituberculosis Vaccine.—The endotoxins of the tubercle bacillus are derived either from its fatty capsule or from its protein stroma. Those derived from the capsule are the etherobacillin and the chloroformobacillin of Auclair, the former producing caseation, the latter sclerosis, while both can induce fibrinous pneumonia and suppuration. From the stroma is derived the paranucleoalbumin of Auclair and Paris, which induces congestion and infiltration of the lungs, spleen, etc., and contributes largely to the tuberculous cachexia. The tubercle bacillus exotoxins produce nutritive and vasomotor disorders and fever. The tuberculosis vaccines heretofore used did not contain all the above elements and hence called forth only a partial reaction; they were therefore unsatisfactory. The Dàvila vaccine contains all the endo- and the exotoxins of the tubercle bacillus, attenuated in such a manner as to make it free from violent reaction without impairing its immunity producing property. The initial dose is 2 mgm., gradually increased to 32 mgm. or more. All the untoward effects of the tuberculins are foreign to the Dàvila vaccine even in larger doses. It may be used in the pretuberculous stage as well as in the active process, and in equal doses in children and adults. Children tolerate 32 mgm. at the first administration and as much as 74 mgm. at the second.

The curative and immunizing action of the vaccine is due to its stimulating effect upon the production of antibodies, which neutralize the disease poisons. This is a very complex process. Thus, according to Wolff-Eisner, tuberculolysin, an antibody called forth by the protein endotoxin, lysinizes the toxin in such a manner as to split it into molecules more toxic than the parent molecule. The split products cause the inflammatory irritation in the tuberculous focus, and produce the specific and nonspecific defenses. The focal hyperemia and exudation, however, must not be excessive. Fever and other signs must be avoided. The difference between natural and artificial tuberculinization, according to Sahli, lies in the fact that in the artificial process only a small portion of the toxin comes in touch with the focus, most of it being acted upon by the healthy tissues. Another essential difference is the slow rate of tuberculinization in the natural process. The advantage is on the side of the artificial tuberculinization, especially in the incipient cases. Debility and undernutrition are contraindications. The vaccine has diagnostic value, since it reactivates the von Pirquet reaction. Besides the usual aseptic precautions, the needle and syringe should be cleansed with ether before using. The vaccine is not to be aspirated. The administration is carried out in series of five injections every third or fifth day, commencing with 2 mgm. and increasing each succeeding dose by the multiple of two. In case of reaction from any of the doses that dose is repeated until tolerance is established. The series may be repeated from four to eight times. Fever and intestinal disturbance are contraindications. In such febrile cases one may try to commence with half the usual dose, but generally the treatment is unsatisfactory. In incipient cases a diurnal temperature curve of between 96.4 and 99.1 becomes more level under the influence of the vaccine. Increase of weight is general. Females react less favorably. Hemoptysis calls for a once a week administration of the three lower doses until it ceases. There are no sequelae. Sputum and bacilli increase for a day or two after injection, but decrease thereafter, the sputum becoming more mucoid in character. All other methods of treatment such as climatic, dietetic, rest, etc., augment the effectiveness of the vaccine.—*Atoxic Antituberculär Vaccine, J. Dàvila, Sanidad y Beneficencia, April, 1919, xxi, 356.*

Intracutaneous Tuberculin Treatment of Pulmonary Tuberculosis in Children.—Garcia and Cordero relate their experiences with Mantoux's intracutaneous technic applied in systematic tuberculin treatment of children, analyzing the cases in which no benefit was realized. Those cases, in which the method failed, proved useful guides for selecting other cases for the method and for the proper doses until highly favorable results could finally be counted on. To begin with, they state that dispensary treatment by subcutaneous injection of tuberculin has too many drawbacks and dangers, but the intracutaneous technic is free from these to a large extent, while the response to the intra-

cutaneous injection is an instructive index of the individual tolerance at the moment, often rendering careful analysis of the temperature, weight, etc., unnecessary. The intracutaneous technic allows a tentative course of tuberculin treatment without danger for the patient, even when it proves ineffectual.—*A propósito del empleo terapéutico de la tuberculina por via intradérmica en la tuberculosis pulmonar de los niños, J. Garcia del Diestro and B. Cordero, Arch. Espan. d. Pediat., January, 1920, iv, 5.*

Tuberculin in Lupus Vulgaris.—Eleven cases were treated in two groups; the first and smaller one with new tuberculin, the second with O. T. There was distinct improvement in every case of group 1. The old tuberculin however seemed to be of comparatively little value unless given in intensive doses. It is of help in so far as it brings about the regular attendance of the patient. It does not interfere with other methods of treatment.—*The Effects of Tuberculin in Lupus Vulgaris, R. Aitken, Edin. M. J., April, 1920, xxiv, 251.*

Protein Therapy in the Cachexia of Tuberculous Children.—In the early stages, tuberculosis shows a great tendency to spontaneous healing, and any agency which is likely to raise the resistance of the organism will increase the percentage of cures. The prognosis is worst in those cases with extreme cachexia and malnutrition, great weakness, apathy, high fever, complete anorexia and tendency to edema. It was this class of patients in which the authors were interested, and as no means of influencing the active tuberculous process has been discovered up to the present time, they attempted, by means of protein therapy, to combat the cachexia, and in this way increase the general resistance. At first they injected 10 cc. of horse serum subcutaneously twice a week. Later, because of frequent serum reactions, they reduced the amounts of serum injected to ½ cc. at the first injection, then 1 cc., and finally 2 cc. The maximum number of treatments was put at 100. Of 26 almost moribund children so treated, 9 died. In most cases, however, they feel there was a distinctly beneficial effect on the patient, this being manifested by both objective and subjective improvement—better appetite, less apathy, less fever, diminished tendency to edema, and a more marked reaction to the skin tuberculin tests. No focal reactions were observed. Two typical case reports are appended.—*Die Proteinkörpertherapie der Kachexie tuberkulöser Kinder, A. Czerny and H. Eliasberg, Monatschr. f. Kinderh., April, 1920, xviii, 1.*

Artificial Pneumothorax.—Cases of remarkable recoveries from artificial pneumothorax are a part of the records of every sanatorium using it. At the Mt. Regis Sanatorium it has been the rule to establish pneumothorax only in the unfavorable cases, unresponsive to thorough sanatorium treatment. Other cases, however, have likewise shown most gratifying improvement from the procedure. Compression is justified and frequently beneficial in cases with infiltration of all or part of one lung and a moderately diseased area in the other, if there are no complications. Conditions are not the same in all patients as regards the degree of compression required. One patient may stand comfortably only a −2 or 0 pressure—in centimetres of water, while another can submit to +20 or +30—used to break adhesions—without material discomfort. At first 200 or 300 mils of gas are injected, and this amount repeated on the following day. The intervals are then gradually lengthened by skipping one, two, three days, etc.—just slowly compressing until full collapse is attained. To maintain uniform pressure, a close watch is kept over the patient. The fluoroscope permits of judging more accurately the needs in individual cases, the effects of pressure on the mediastinum, the presence and location of adhesions and fluid accumulations, the effects on the free lung, and the meaning of obscure auscultatory signs. Careful surgical technic is essential to success. The site of puncture should be over healthy lung tissue, if possible.—*Artificial Pneumothorax, F. G. Simmons, Virg. Med. Monthly, January, 1920, 257.*

Artificial Pneumothorax.—The ordinary Saugman needle has no provision for excluding communication with the external air when the stopcock is opened to admit the stylet. To obviate this defect the author has designed a special needle with a little stuffing box like that of Potain's aspirator screwed into the mount with a washer to insure perfect tightness. The distance from the stopcock of the needle to the stuffing box is 4.5 cm. It has a round cutting edge rather than a sharp point and a specially constructed holder. In use the holder is adjusted so that the length of needle projecting through the cover-plate corresponds with the estimated thickness of the chest wall, and so that it may be readjusted in situ if necessary. As soon as satisfactory oscillations occur, even an unexperienced assistant, by keeping the holder pressed against the patient's chest, can hold the needle in the proper position without danger of thrusting it in more deeply or partially withdrawing it. The stylet should be long

enough to project about 1 cc. beyond the point of the needle, as it then serves as a probe; it should be ground perfectly flat, so as to push the visceral pleura before it without inflicting a puncture.—*A Note on Artificial Pneumothorax, F. C. Cooley, Brit. M. J., March 27, 1920, 432.*

Treatment of Tuberculous Peritonitis with the Quartz Lamp.—There were 21 cases treated, including 12 children. General exposures were employed with great improvement in all but 6 cases. The result is obtained by a something which is carried by the blood stream. There was rapid disappearance of fluid and marked general improvement. In one case the circumference of the abdomen decreased 10 cm. in a very few days.—*Behandlung tuberkulösen Peritonitis mit der kunstlichen Höhensonne, Laquerer & Lasser-Ritscher, Med. Klin., 1918, 291.*

Theory of Light Treatment in Surgical Tuberculosis.—The combination of sunlight with hyperemia treatment should be the method of choice in treating bone tuberculosis. More than 100 cases of severe types, generally complicated with fistulae, were treated and they were healed in a surprisingly short time, returning to normal function. Both agents act by setting up a hyperemia.—*Zur Theorie der Lichtbehandlung chirurgischer Tuberkulosen, E. Kisch, Münch. med. Wchnschr., 1917, 614.*

A Clinical Method of Dosage of Ultraviolet Rays.—The unit of quantity is the quantity of ultraviolet ray which acting normally on a decinormal solution of silver nitrate of 1 cm. thickness can reduce 1 mgm. of silver per scm. Having got this unit, thick paper soaked in a 20 per cent solution of potassium ferrocyanide was used. On exposing this paper to ultraviolet rays, the color passes from the initial white to a deeper and deeper yellow, through all the stages of cream and sulphur shades. The changes of tint of the indicator under the influence of different doses of rays, reckoned in the unit of quantity, were then observed; and at the same time the different skin reactions to these different doses were noted. The indicator is termed the chromo-actinometer. This consists of 5 tints which are those taken by the reacting strip and correspond to the following doses: ½ unit, 2 units, 6 units, 12 units and 18 units of quantity. Then the skin effects of each of these doses, as measured by the indicator, are as follows:

½ unit—slight erythema
2 units—erythema followed by desquamation
6 units—photo-epidermatitis
12 units—intense photo-epidermatitis
18 units—photo-dermatitis

The author uses these reactions especially for treating skin affections, and with his method of dosage he has been able to study the quantity of rays emitted, varying with the intensity of the current of the lamp in a given time, and has also been able to show the age of the quartz light.—*A Clinical Method of the Dosage of Ultraviolet Rays, H. Bordier, Arch. Radiol. & Electrol., April, 1920, 366.*

Biological Action of the Ray.—Small doses of quartz light give good granulations while large doses destroy. Absorption of the ultraviolet ray occurs in the corneum layer while the biologic action occurs in the pigment layer. There is a latent period between the exposure to the ray and the inflammatory response, which period allows the toxin to diffuse. If a wet bandage is placed on the skin before the ultraviolet exposure, the action is weaker; but, if diathermia is first used, there is a more rapid carrying off of the so called toxins to the depths, and therefore the local reaction to the ultraviolet rays is less. Climate is of value because of irritation to the skin by sun and cold air. The author theorizes that the corneum layer, by means of a fluorescence developed under the action of the ultraviolet ray, can send out rays of longer wave length and that his so called beta rays are developed. The latter produce chemical changes at the place of their absorption. Small doses of sunlight give the best results by stimulation. Hesselbach showed that after the use of ultraviolet rays there were decreased number of breaths but deeper breathing to compensate. There were questionable changes in the red cells and the hemoglobin, but the polymorphonuclear cells were decreased. The author speaks of a spectrosol lamp which gives good results, developing a good pigment. It is weaker than sunlight but has a similar qualitative spectrum.—*Über biologische Strahlenwirkungen, T. Christen, Strahlentherapie, 1919, ix, 165.*

The Harm to the Eyes through Light.—People after working in snowy surroundings see everything as red on entering a dark place. This is due to the after-effect of the short visible rays of the spectrum influencing the retina. The ultraviolet rays may cause a scotoma for many weeks.

Light rays may cause a central dark spot on the retina by being concentrated on the fovea. The retina is rather safe from the ultraviolet rays because the latter do not penetrate, but the long waves may have an action on the retinal pigmented cells. The ultraviolet rays may cause cataracts as is seen among glass-blowers.—*Die Schädigung der Augen durch Licht und ihre Verhütung, Birsch-Hirschfeld, Deutsch. med. Wchnschr., 1918, 882.*

Influence of the Sun on the Circulating Lymphocytes.—Blood counts were made on 38 individuals before going to Woods Hole, Mass., for their summer vacation, and on returning. Chronic sunlight dermatitis or pigmentation was accompanied in 25 of the 38 cases by an appreciable increase, both absolute and relative, in the number of circulating lymphocytes. Out of 13 with no increase, 6 failed to tan, 3 were so dark originally that it was impossible to determine an increase and 5 had a very high count from the first. It seems probable that the lymphocytosis observed in the majority of cases, which resembles the response of animals to small doses of X-ray, is due to the effects of the ultraviolet ray, although one cannot eliminate the effect of the infrared rays or heat waves.—*Effect of Exposure to the Sun on the Circulating Lymphocytes in Man, H. D. Taylor, J. Exper. Med., January, 1919, 41.*

The Tuberculosis Problem.—The pathologists claim that the majority of the population are at some time or other infected with the tubercle bacillus, but only a certain proportion develop an active and fatal disease. If that be so the primary question to be solved in the study of tuberculosis is what physiological and environmental factors are responsible for maintaining the individual's immunity, and what factors break down his resistance and help to develop the active disease. Almost all the machinery in the struggle against tuberculosis has been directed to the recognition of the disease and its appropriate treatment, and to the attempt to prevent infection and reinfection. But correct diagnosis and treatment of those who are ill are not sufficient. Tubercle is the index disease of social conditions and it can be dealt with successfully only when we begin to study and understand the causes of immunity in those who are infected but not diseased, and of vulnerability in those who succumb. Sanatorium treatment is of value, but it would be much better to try to provide such conditions of life and labor as would render the expensive sanatorium unnecessary. Not only would such conditions prevent a large amount of tuberculosis, but also many other evils associated with bad social environment.—*Some Aspects of the Tuberculosis Problem, T. D. Lister, Lancet, February 21, 1920, cxcviii, 425.*

Needed Changes in Antituberculosis Work.—The writer advocates a campaign against tuberculosis by (1) education through the newspapers teaching the public the various signs of early tuberculosis and by placards in public places, and (2) legislation, e.g., drastic laws against promiscuous expectoration, a place of detention for incorrigible consumptives, reporting of every case of tuberculosis, municipal control of milk supply, laws against quacks. All persons should be examined for tuberculosis every three years. Each state should have a tuberculosis department to provide for impecunious cases. Physicians should learn to make early diagnoses. Public opinion must be educated to this end.—*Needed Changes in Antituberculosis Work, H. F. Gammons, Dallas M. J., April, 1920, vii, 11.*

Reforms in Campaign against Tuberculosis.—The campaign against tuberculosis has two distinct phases: (1) curative measures dealing with the infectious agent; (2) preventive measures dealing with the sociological and economic conditions, which turn a comparatively benign parasitic invasion into a cause of sickness or death. Much of the present day schemes have to deal with the treatment of the sick; and whether the infectiousness of the tubercle bacillus is high or low, the effort in the direction of cure is practically wasted for purposes of prevention. Diagnosis is paramount, and although difficult at times, it frequently is not made because of a deficiency in medical education. Therefore, practitioners have to receive a better training in all matters concerning tuberculosis. As regards the institutional treatment of tuberculosis the following suggestions are offered: (1) To confine treatment in ordinary sanatoriums to the early cases. (2) To provide homes for advanced cases, but without compulsory segregation, since the patient as the source, and the tubercle bacillus as the specific cause, of the malady represent only one phase of the etiology and a relatively less important one at that. (3) To provide farm colonies for consumptives and convalescents. The alleviation of distress achieved thereby does but little for the eradication of the socio-economic causes which produce it. (4) To throw the cost of these various institutions upon the public fund. The tuberculosis officership is in need of reform. Part time position and adequate pay would meet this need, and would also

provide leisure and facilities for reading, thinking and teaching. Then again in-patient work as well as out-patient and administration work would tend to neutralize the cramping influences of this officership. Promotion to the chief tuberculosis office position shall be made from amongst the tuberculosis officers. Private practice should be permitted. The preventive measures are largely economic and political. Adequate housing and distribution of the population are foremost problems. Poverty, overcrowding, lack of fresh air and of sunshine have scientifically been determined to be the most important etiological factors in tuberculosis. A proper preventive measure is the open air school, which, however, ought to be instituted universally and not limited to a small portion of the tuberculous children. Education to counteract ignorance and superstition will be made possible only when the recipient is not overworked, not anxious, and not dulled by the monotony of his occupation. Industrial welfare should be more widespread. All the above measures implying an economic revolution can be brought about not through bureaucratic decrees, but rather through the awakening of the mass of the people to the vital issues of public health.—*Suggested Reforms in the Campaign against Tuberculosis. S. V. Pearson, J. State Med., May, 1920, xxviii, 144.*

Village Tuberculosis Settlements.—A deputation recently visited the British Minister of Health to urge the establishment of village settlements for tuberculous ex-soldiers as recommended in the Report of the Interdepartmental Committee on Tuberculosis. This report also recommended additional sanatorium accommodation and increased provision for training of tuberculous ex-soldiers. The reason presented for the establishment of such village communities was that sanatorium treatment, even where accompanied by training in suitable occupations, had been found to be inadequate as a means of combating tuberculosis, because patients who returned from the sanatorium to ordinary conditions of life and work were unable to maintain health and earn a living permanently. In the village settlement one could work under conditions that would enable him to maintain his health and have his family with him. The ex-soldier's earnings would be supplemented by his pension, but in the case of the civilian the earnings would have to be supplemented in some other way. The community however would gain in the result by the prevention of the spread of infection and by the fact that the patient would remain a productive worker. It was stated that out of thirty cases, that had come to the Cambridgeshire Tuberculosis Colony from sanatorium treatment and training, not one had died in four years. The Minister of Health assured the deputation of his good will and favorable attitude toward the village settlement plan.—*Village Tuberculosis Settlements, Editorial, Brit. M. J., April 3, 1920, 476.*

The Municipal Workshop for the Consumptive Ex-Soldier.—In the treatment of the tuberculous the need has been increasingly felt for some method of consolidating the benefits gained by sanatorium treatment and providing suitable employment for arrested cases before returning them to work under competitive conditions. A scheme has been devised for ex-soldiers in England suitable for any township, whereby municipal workshops are established providing first training in occupations suitable for arrested tuberculous cases, and later gainful employment at these occupations, in such localities where the men may set up a home. The work should consist of light manual employment in selected trades graded from fairly heavy work to the lightest possible. Carpentry and cabinet-making represent the first type, basket-making the second. The shops should be open for eight hours a day, but the time each man should work must be regulated by the medical officer. Each hour of work should be paid for at the union rate for that trade. The midday meal should be provided for at the shop, and provisions made for proper rest periods. A home-visiting schedule would also be a necessary part of the plan to provide aid and advice in maintaining proper home hygiene. Under this plan, many men will become able to work the full day, and in some cases men will be able to return to ordinary industry after one or two years in the workshop. In other cases the workshop period must be longer, and in others permanent. But any loss in this latter group will be compensated for by preventing infection in ordinary workshops and the consequent fresh incidence of tuberculosis. Soldiers, of course, in addition to their wages would receive pensions assessed according to their disability.—*The Municipal Workshop; a Scheme for the Post-Sanatorium Employment of the Consumptive Ex-Soldier, F. S. Turner, Lancet, February 21, 1920, 457.*

Schemes and Methods in Tuberculosis Work.—Gradual increase in the earning power and leisure of the general population, rehousing schemes, supervision of milk supply, voluntary notification of phthisis, etc., had done much to reduce the incidence of

tuberculosis even prior to the 1911 National Health Insurance Act. The latter provides, in addition to the above measures, "sanatorium benefit" for insured and dependent persons, and pending admission to the sanatorium, domiciliary and dispensary treatment with or without a grant for extra nourishment. The resources practically limited the operation of the act to the insured, being entirely inadequate for the dependents. Amalgamation of the Local Insurance Committee with the Local Sanitary Authority and the pooling of their funds provide for the distribution of the expenditure between the rates and the insurance fund. A diagram of the scheme is as follows:

Ministry of Health

Sanitary Authority (Rates)
- Insured persons
- Dependents
- Non-insured
  - Institutional treatment
  - Dispensary treatment

Insurance Committee (Fixed income)
- Insured persons
- Dependents
  - Domiciliary treatment
  - Extra nourishment

Thus domiciliary and dispensary treatments are not available for the noninsured and the nondependents. This break in the campaign against tuberculosis should be filled by an authorization to expenditure for this purpose by the Health Ministry (Public Health Act, Oct., 1913). Suitable accommodations, suitable employment and financial help are the essence of the after care of any of the three types of treatment. Colony settlements run by Sanitary Authority, constant help and advice by means of visiting by the After Care Committee, financial assistance to the patient or his dependents to compensate the diminished earning power, would tend to increase the standard of living and hence the resistance of the consumptive. Segregation is an important function of the sanatorium. But the accommodation of well equipped institutions is wasted upon advanced cases. The special ward for advanced cases is not a solution, since the patient regards the admission thereto as equivalent to a death warrant and prefers to return home. Compulsory segregation would solve the problem, but is naturally objectionable. Some isolation scheme free from compulsion is desirable. The monotony of the sanatorium life makes it difficult to persuade the patient to remain there an adequate time. Without impairing the discipline the daily routine must be arranged with a provision for interest, amusement and recreation. Prevention of tuberculosis is more important by far than its cure. The chief effective measures operating in that direction are rehousing, milk supply supervision, and segregation.—*Schemes and Methods in Tuberculosis Work, B. T. J. Glover, J. State Med., May, 1920, xxviii, 140.*

Community Responsibility at the End of Sanatorium Treatment.—Most tuberculous patients when discharged from public sanatoriums are not cured, but merely improved, with arrested or quiescent lesions, and, if subjected to unfavorable conditions, are in danger of breaking down. The sanatorium is properly a great training school for the tuberculous where they are taught how to live, to secure and retain arrest of the disease. For the best results a social service follow-up system should be established by every sanatorium. A public health nurse or similar officer should visit the patient's home, and see that proper conditions are established for healthful living, and patients should be taught to visit the clinic on the slightest sign of any renewed activity of the disease, or routinely once or twice a year if there are no unfavorable symptoms. His work should be selected according to his physical condition, and it should be seen to that his working environment is sanitary and wholesome. Very few sanatoriums have any satisfactory follow-up system, but it is the duty of the community to render this further service to the patient, which will give the greatest possible returns on the money expended for sanatorium treatment.—*Does Community Responsibility End when Sanatorium Treatment has been Given? R. C. Kirkwood, Med. Rec., May 1, 1920, xcvii, 738.*

Tuberculosis in Albania.—A survey just completed by American Red Cross doctors in Albania shows that there are over 300,000

cases of tuberculosis in that country, 80 per cent of the entire population being affected. —*News of the Week, Med. Rec. June 19, 1920, xcvii, 1049.*

Tuberculosis and Economic Conditions of the Poorer Population in Trier. —House to house visits were made at the homes of 1017 of the poorer families of Trier by German speaking nurses of the U. S. Army Corps in 1919. There were 282 families with a history of tuberculosis, and 379 families where some member had tuberculosis. There were 343 cases of pulmonary tuberculosis, 249 cases of scrofula, and 43 cases of other forms of tuberculosis. The children were most frequently affected. The diagnosis of scrofula had often been made by the family physician, and probably more frequently than the symptoms warranted. The families visited included many who came to the German dispensary on account of sickness. The visits showed the frequency of tuberculosis, also the infected surroundings, and the kind of human material which would prove an easy prey to the tubercle bacillus. The investigation revealed very clearly that the poorer people had suffered great hardships on account of the war, and that disease, especially tuberculosis, had increased due to overwork, neglect of homes and children, largely on account of mothers working out, and especially due to the war rations with its consequent malnutrition.—*Economic Conditions of the Poorer Population of the City of Trier, E. H. Bruns, Mil. Surg., April, 1920, xvi, 418.*

Institutional Accommodations for Tuberculosis.—We recently received the following circular letter from the Surgeon General of the U. S. Public Health Service:

"At the present time, with thousands of cases of tuberculosis among discharged soldiers entitled to medical care and treatment at the hands of the Public Health Service, we find ourselves confronted by the fact that practically nowhere will general hospitals admit this class of patients; moreover there is almost everywhere throughout the United States a lamentable shortage of hospital facilities for those ill with tuberculosis. The opening of general hospitals to this class of patients would do very much more than provide relief for a large class of unfortunates; it would undoubtedly contribute enormously to the efforts now being made to control tuberculosis.

"As conditi ns are now, the interne serving his time in any of the general hospitals has practically no opportunity whatever to familiarize himself with the diagnosis and treatment of pulmonary tuberculosis. It is small wonder, therefore, that so large a proportion of the general practitioners fall so far short in their diagnosis of pulmonary tuberculosis. The present practice also fosters the erroneous belief in some miraculous virtue in climate in the treatment of tuberculosis, yet those familiar with the disease recognize that it is the proper use of fresh air which constitutes the valuable element in treatment at the various well-known sanatoria.

"In an effort to make better provision for the tuberculous among discharged soldiers, and at the same time to help bring about an improvement in our campaign against tuberculosis, Dr. Hugh S. Cumming, Surgeon General of the U. S. Public Health Service, has sent the following telegram to the American Medical Association, now in session in New Orleans, La.:

"I desire to urge more active participation by the general practitioner and by general hospitals in the treatment of tuberculosis. To insure earlier diagnosis, properly train internes and other personnel, popularize treatment in the home climate, provide additional facilities, I earnestly indorse the resolution passed by the National Tuberculosis Association in 1916, recommending that general hospitals should admit tuberculous patients and provide separate wards for that purpose. Sanatoriums and specialists in tuberculosis will always be needed and we should have more of them, but I believe that success in the antituberculosis campaign is largely dependent upon first, convenient facilities for observation and prompt treatment of patients with open tuberculosis, and second, in a sharpened perception and higher degree of skill by which the family doctor will make early diagnosis or even forestall the development of clinical tuberculosis in the adult before a definite diagnosis is possible. To provide adequate care for tuberculous ex-service men and others, to protect infants from infection, enlist the aid of the general practitioner, allay phthisiophobia, and improve home treatment of tuberculosis, the opening of general hospitals to this most common of all serious diseases will materially assist."

While the conditions mentioned may prevail elsewhere in the country, for the past two years there have been constant vacancies in the institutions available to cases of tuberculosis in this city. Of the present available bed capacity of 4,200, there are vacancies to the number of 550. We have recently published several articles in regard to climate in the treatment of tuberculosis. —*Weekly Bull., Dept. of Health, N. Y. City, May 29, 1920, 170.*

$350,000 for Tuberculosis Hospital.—The Marion County Council authorized a county bond issue of $350,000 for new buildings at the county tuberculosis hospital, which was an increase of $50,000 over the amount asked by the board of managers.—*Indianap. M. J., May, 1920, xxii, 251.*

New Tuberculosis Hospital.—Plans are under way for the establishment of a tuberculosis hospital to cost $1,500,000 at Gabriels, N. Y., by the Knights of Columbus.—*News Items, N. York M. J., June 12, 1920, cxl, 1042.*

Tuberculosis Hospital for Public Health Service.—The tuberculosis sanatorium heretofore operated by the army authorities at Fort Bayard, New Mexico, has just been transferred to the U. S. Public Health Service and will soon be available for treating discharged, disabled soldiers. The Fort Bayard Sanatorium will provide the Public Health Service with 1,000 additional beds to care for its tuberculous patients. The present sanatorium at Deming will be held in reserve, specially for winter use. At the Fort Bayard Sanatorium the Public Health Service will treat only ambulatory cases of tuberculosis, in which the prognosis is favorable. Patients will be admitted only after careful observation elsewhere to make sure that their condition is suitable for successful treatment at a high altitude.—*News Items, New York M. J., June 12, 1920, cxl, 1043.*

State Regulation of Boarding Houses for Tuberculosis.—A bill introduced into the New York State legislature by Senator Julius Miller provides for the licensing of boarding houses for tuberculosis patients and for their supervision by the State and local health boards. Tuberculosis patients will be permitted to go only to country places where the climate is suitable, the houses maintained in sanitary condition consistent with the demands of the sufferers, the food adequate, and medical supervision for emergencies furnished by the State. Patients unable to pay will be aided by the State. Others will be required to pay one third of their expenses, one third will be paid by the county and the other third by the State.

Tuberculosis in Relation to Life Insurance.—Romanelli analyzes May's report on this subject, and compares the conclusions with his own experience, which suggests the advantage of postponing acceptance of a candidate who has recently had a tuberculous process in a bone or joint, in the urinary apparatus or peritoneum. In 75 per cent of his cases, when pulmonary tuberculosis developed later the interval was not over three years. With a clinically cured pulmonary lesion, he warns that there may still be fire under the ashes, and a trauma or infectious disease may fan it into a flame. This occurred in many cases during the influenza epidemic. A ten year interval, however, is a good guarantee, other things being equal, with a progressively decreasing extra risk premium.—*La tubercolosi in rapporto all'assicurazione vita, I. Romanelli, Policlin., January 5, 1920, xxvii, 9.*

Labor Tuberculosis Association Committee.—At a recent conference in New York of the New York Tuberculosis Association and the Labor Sanitary Conference, a joint committee was appointed consisting of five representatives in each organization. The work of the committee will consist in endeavoring to reach labor bodies and trade councils, particularly individual unions representing the greatest health hazard, distribution of literature, arrangement of talks and exhibits, encouragement of shop sanitation committees, health lectures, and in arranging, if possible, for confidential medical examination of employees or members of unions in the workshop or in coöperation with occupational or tuberculosis clinics. The members of the committee are: For the New York Tuberculosis Association: Dr. Louis I. Harris, chairman, Dr. George M. Price, Dr. Edward McSweeny, John Fitch and Paul Kennaday. For the Labor Sanitation Conference: Alfred Boulton, Miss Maud Swartz, Meyer Abramson, Frank Byrne and Frederick Gaa.—*Editor. Notes, N. York M. J., March 6, 1920, cxl, 429.*

Tuberculosis in Husband and Wife.—In an investigation which covered 1,000 successive dispensary cases, Minnig found that 502 of the patients were married and 498 were single. Among these 502, there was active tuberculosis in husband and wife in 44 cases, or 8.7 per cent. Of the 44 cases, 22 of the consorts had died of tuberculosis, or 50 per cent. Of the 22 surviving consorts, 17 were men and 5 were women. In these 22 tubercle bacilli were present in 12 of the widows or widowers. The period of illness extended from four months to twenty years. Minnig did not include in the 44 any cases in which, for instance, there was dulness with suppressed breath sounds or even bronchovesicular breathing at one or both apices and a vague history of pleurisy or other mild symptoms, but no moisture. No doubt many of these were tuberculosis carriers, yet not clinically open cases of

tuberculosis; but they were open cases part of the time.—*Incidence of Tuberculosis in Husband and Wife, A. Minnig, J. Am. M. Ass., May 22, 1920, lxxiv, 1445.*

Respiratory Disease Transmission by Inanimate Objects.—Cumming has suggested, in discussing the transmission of influenza and influenzal pneumonia, that the hands are important factors in the conveyance of germs to healthy persons, and furthermore that hand-to-mouth infection will account for the major part of this transmission. In these studies the methods of washing army mess-kits were particularly concerned, as the wash water served as a means for the contamination of the hands in the groups showing high influenza rates. In a later article, Cumming reports the results of a study of pneumonia in institutions, in some of which eating utensils were washed by hand and in others by machine washers. In the first group the pneumonia rate was much higher than in the second group. Still more recently the same investigator has laid primary emphasis on tableware, particularly spoons, forks and knives, as a means of transmitting tuberculosis. This point of view is confirmed by deaths of guinea pigs from tuberculosis in 25 per cent of instances after injections of sediment from water in which spoons used by tuberculous patients had been rinsed after washing. In accepting these findings, however, it should be remembered that in intelligent households silverware is usually both washed and rinsed before being used again. It would be interesting to know the influence of the combination of these operations on freeing spoons from tubercle bacilli. The work of Cumming focuses the attention of sanitarians on other means of conveying germs of respiratory diseases than by droplet infection directly from mouth to mouth. More data are needed to show that these means are really the major ones. It is probably true that the inanimate objects and hands are capable of conveying disease germs as well as are the infectious droplets, and it is possible that too little attention has been given to them.—*Editorial, J. Am. M. Ass., May 22, 1920, lxxiv, 1462.*

Pathologic Respiratory Conditions as Affecting Shape of Chest.—Wenckebach's article supplements one published in 1907 on the pathologic relations between the respiration and the circulation. He here discusses the six main factors influencing the form of respiration and shape of the thorax, e.g., (1) the bony thorax and the spinal column, (2) the influence of gravity on the shape of the thorax, (3) the abdomen as support of the thorax, (4) the elastic traction of the lung, (5) the forces of respiration and (6) importance is ascribed to extreme leanness as this allows the so called asthenia shape of the thorax to develop even without any constitutional anomaly or congenital predisposition. The muscles of the back play an important rôle in quiet, unconscious respiration as well as in forcible inspiration. Humming with the lips closed, as a breathing exercise and for study of the action of the abdominal muscles is highly commended. With this, the diaphragm is drawn up extremely high in the chest as the humming continues to the limit of expiration. Coughing is still more instructive for study of the muscles involved in respiration. The diaphragm like all other muscles is subject to reflex influences, and its excursions can be modified from distant points. When breathing quietly, with mouth closed, if the mouth is opened suddenly, the diaphragm rises a little. Continuing the even breathing with the mouth open, it is evident that conditions in the respiration are quite different from what they were before. The sinking of the root of the tongue when the mouth is opened may explain this difference in the tonus of the diaphragm. Whatever the explanation, there is no doubt that this modified behavior of the diaphragm is an element not to be overlooked in habitual mouth-breathing.—*Uber pathologische Atmungs- und Thoraxformen, F. Wenckebach, Wien. Arch. f. inn. Med., March 1, 1920, i, 1.*

Occupation and Tuberculosis.—Indoor workers are more prone to respiratory diseases because they are frequently crowded together, and their work requires faulty posture. The protection afforded by the nose and throat is gradually overcome and the dust reaches the lungs or is swallowed with the saliva. The character of the dust determines the amount of the resulting injury. When the chemical composition of the dust is similar to the natural constituents of the body, as in the case of lime workers, the damage is less. Only the finest particles of dust reach the lungs. There is a great discrepancy in the number of deaths in peoples of different trades who are exposed to the same kind of dust The metallic dusts are the most frequent cause of pulmonary fibrosis. The presence of dust alone does not account for the undue prevalence of tuberculosis in certain occupations. Everything which undermines the general health, such as alcohol or inherited weakness, are important contributory factors. Welfare legislation, factory sanitation, and per-

sonal hygiene have produced gratifying results.—*Occupation in Relation to Tuberculosis, G. M. Kober, Pub. Health Rep., March 26, 1920, xxxv, 751.*

Tuberculosis in Dogs and Cats.—Petit expatiates on the facility with which human tuberculosis is transmitted to dogs and cats, and the danger of infection from those with intestinal, pulmonary and open skin lesions. Any dog or cat should be regarded with suspicion when it is growing thin and coughs, or has a diarrhea or persisting ulceration on the face or neck. The pus from these latter lesions in particular swarms with tubercle bacilli.—*Les formes ouvertes de la tuberculose chez les carnivores domestiques, G. Petit, Bull. d. l'Acad. d. Méd., November 18, 1919, lxxxii, 310.*

Toll of Cattle Tuberculosis.—Tuberculosis was responsible for the condemnation of more cattle, slaughtered under Federal meat inspection last year, than all other diseases combined. Information fron the Bureau of Animal Industry, United States Department of Agriculture, shows that 59,547 carcasses of cattle were condemned on postmortem inspection, and of that number 37,600 were the result of tuberculosis. In addition 53,652 parts of cattle carcasses were condemned for the same cause.—*Matters of Current Interest, Am J. Vet. Med., June, 1920, xv, 45.*

Thermal Reaction Following Intracutaneous Injection of Tuberculin.—Investigations at the University of California Experiment Station have pointed out that the intradermal injection of tuberculin in suitable doses gives rise to a thermal reaction similar to the one obtained by the subcutaneous method. The intracutaneous dose used by the California state veterinarian in official testing, 0.2 cc. of 5 per cent solution of alcoholic precipitated tuberculin, is sufficient to bring forth this result. The practical application of these observations is evident. One may, by one injection, make use of two diagnostic manifestations of tuberculin application, namely, general reaction as indicated by rise in temperature and a local reaction. The San Francisco County Medical Milk Commission has recently adopted this method of testing for additions to herds producing certified milk. The subcutaneous test was formerly used. When only one observation can be made, we have made it at seventy-two hours, others prefer ninety-six hours. Some reactions do not occur until after the seventy-second hour, but we are not satisfied that there is not an equal or larger number of cattle in which definite positive reactions have been present but disappeared before the ninety-sixth hour.—*Am. J. Vet. Med., June, 1920, xv, 295.*

Percentage of Tuberculous Cattle Reduced.—Extensive tests recently made by State Veterinarian Swingley, in Yakima County, Washington, show a reduction in the number of cattle affected with tuberculosis, the percentage being 6 per cent, as against 7.51 per cent six months ago. Most of the herds in the Yakima Valley have been given clean bills of health. Of 2009 cattle tested, 121 reacted, were condemned and destroyed, the estimated value of the animals destroyed being $27,000, which includes forty-five pure-bred herds, some of the finest registered pure-bred cattle in the country. The value of the grade cattle is estimated at $125, the pure-breds at $250, not including the fancy, high-priced animals.—*Current Comment, Am. J. Vet. Med., May, 1920, xv, 38.*

Grippe and Pulmonary Tuberculosis.—Three cases of latent tuberculosis are reported which became active after an attack of influenza. Two of them developed a rapid downward course and succumbed. The third case withdrew from observation with signs of active tuberculosis.—*Grippe et tuberculose chronique, J. Lortat, Progr. Méd., February 28, 1920, lx, 91.*

Tuberculosis of the Conjunctiva.—An infant of 8 months developed an ulcer of the right eye during an attack of double pneumonia. Both lids were thickened; there was mucopurulent discharge, a necrotic ulcer on the upper tarsal conjunctiva, and numerous small nodules studding the conjunctiva. On the lower lid there were also nodules, some of which coalesced to form an ulcer. The preauricular, submaxillary and cervical lymph nodes on the right side were much enlarged. The von Pirquet test was negative. But an excised piece of the ulcer was found to be tuberculous, both the characteristic structure and bacilli being present. The child died. No autopsy.—*Tuberculosis of the Conjunctiva, D. H. Coover, Am. J. Ophth., March, 1920, iii, 206.*

Laryngeal Tuberculosis.—It is generally conceded that tuberculosis of the larynx is secondary to tuberculosis of the lungs. Although in a very small proportion of cases the laryngeal symptoms appear to occur primarily, physical examination and the X-ray reveal a primary involvement of the lung. The lymphatics and the blood vessels have been shown to be responsible for carrying the bacilli to the larynx. The first symptom of laryngeal trouble is hoarseness;

ater there is aphonia, painful deglutition, and dyspnea. The appearance at first may not be characteristic; the larynx may be reddened and the vocal cords congested. The following are pathognomonic pictures: a pale, grayish color with cords lax, flabby and possibly nodular; a very slight ulceration of the epiglottis or ventricular bands; miliary tubercle, under the mucous membrane; ulcerations of the aryepiglottic folds and club-shaped thickening of one or both arytenoids. In the terminal stages, there is destruction of the cartilage with abundant secretion. In some cases where laryngeal symptoms are suggestive, the diagnosis of tuberculosis must be established by a thorough examination of the lungs. In advanced cases gummatous ulcerations may be mistaken for tuberculosis, and a Wassermann should be made. Carcinoma must be excluded by a microscopical examination of an excised cauliflower excrescence. The prognosis is dependent on the pulmonary involvement; if the lung condition is amenable to treatment, improvement of the laryngeal symptoms follows. The same treatment benefits both. In laryngeal tuberculosis a life at high altitudes is especially beneficial; in no other condition does climatic influence play so important a rôle. In the later stages, distressing symptoms must be relieved as they arise.—*Tuberculosis of the Larynx, H. Kunz, Laryngoscope, March, 1920, xxx, 150.*

Phototherapy of Laryngeal Tuberculosis.—Blegvad describes his success in 52 cases of laryngeal tuberculosis treated by general exposures to the carbon arc light. Each case is reported in detail, with illustration of the findings before and after. The patient reclines, undressed, under the light from four powerful (20 amperes) arc lights, four patients at a time sharing the light bath. From fifteen minutes at first, the exposures are lengthened in a week to an hour and were never given longer than this. Among the 74 patients thus treated, the laryngeal tuberculosis healed completely in 17. In 16 the tuberculous process continued its course unaffected. Most of the patients had concomitant pulmonary tuberculosis, and some in an advanced stage. The ulcerative processes in the larynx promptly subsided under the phototherapy which was sometimes supplemented with local measures, especially the galvanocautery according to Grünwald's method. The course of treatment lasted from two to four, six or more months; some of the patients took two courses with several months' interval.—*Demonstration af Billeder af Larynxtuberkulose, N. R. Blegvad, Hospitalstid., March 3, 1920, lxiii, 129.*

Lupus of the Upper Air Passages.—The greater number of cases of lupus of the upper air passages occur in females and in the second and third decades of life. The primary focus in these cases is the nose. This was the case in 113, or 88 per cent, of 128 cases studied. The first symptom is a blocking of the corresponding nostril. Examination shows crusting on the affected area, usually the anterior end of the inferior turbinate; and when the crust is removed, a pinkish, granular surface is seen that bleeds easily. As the disease progresses there is considerable destruction of tissue. The disease may spread by direct extension, or by the lymphatics, to the tear sac, the alveolus, hard or soft palate, uvula, pharynx, and the larynx. In lesions of the palate and uvula, the mucous membrane is more granular than in the other regions affected. In the pharynx the posterior wall is usually affected, and the lesions appear as small nodules. Scarring is a distinct feature. In the larynx the lesions vary from simple redness to practically complete infiltration, which may continue to nodular infiltrations and eventually ulceration. Treatment may have an inhibitory effect, but few cases are cured. Among the agents employed are tuberculin, salvarsan, electrical ionization, curetting with or without application of lactic acid, electrocautery, Pfannenstiel's treatment, X-ray. The first three methods named have been abandoned. For lupus of the nose, Pfannenstiel's treatment is distinctly helpful (KI internally and H_2O_2 locally with the idea of having nascent iodine act on the foci). The X-rays are employed in selected instances. Two cases were treated also with the Finsen rays and both were benefited.—*Lupus of the Upper Air Passages: Report on 128 Cases, R. Webber, J. Laryngol. Rhinol. & Otol., January, 1920, xxxv, 7.*

Perihilar Bronchopneumonic Pseudolobar Phthisis.—In hilum tuberculosis the foci may be small, disseminated and nodular or larger and nodal, producing a characteristic dappled appearance on the radiogram. At times the nodal shadows become aggregated and then combined by intervening less dense opacities, consisting of condensed tissue often containing dilated and thickened tubes; in other shadows there are extensive tracts of pseudolobar homogeneous consolidations approaching in aspect those present in pneumonia and pneumonic phthisis. Perihilar disease may be secondary to apical lesions of a minor or latent character which for some reason have been reactivated; frequently both apices are normal. Occasionally there may be impaired breath sounds, granular or interrupted breathing at one

apex with some diminution of one supraclavicular isthmus. These are generally the persistent signs of a latent or arrested tuberculosis and not an indication of the activity. In the perihilar types, which show tracts of pseudolobar disease, symptoms such as cough, pyrexia, emaciation, and anorexia may become conspicuous before the diagnostic signs appear, or such radiographic shadows may be associated with quiet phases of the disease when the signs become minimal.

It is shown that perihilar fibrocaseous tuberculosis may be almost entirely unilateral. If bilateral the pulmonary lesions are not, as a rule, contemporaneous; one may be subacutely progressive, while the other is manifestly quiescent, even retrogressive. They arise in connection with hilar or perihilar glands on the same side. At times the disease may arise from apical lesions. During its subsequent evolution, cavities may form in the perihilum, and a second group of aerial foci may proceed from them which may be partial—affecting the diseased side only—or it may be general.

The disease advances in the upper lobe towards the axilla; in the lower lobe towards the costophrenic sulcus, finally, in each case, producing a cuneate tract of infiltration with its apex situated at the hilum. In the left upper lobe the opacity may be fanshaped. As the lesion advances centrifugally it becomes more superficial, until in certain areas the characteristic tuberculous râle becomes audible. In the earlier stages, posttussive inspiratory crepitations may be audible. Mistakes may be made by the clinician, who thinks only of the apical crepitations and does not auscultate the fissures, the axilla, and the base. Pleuritic pains in the axillary regions and right basal effusion are not infrequent. The latter are more likely to occur when the middle and lower lobes are invaded. Basal effusions may be encountered in middle age. They may be accompanied by serious cardiac embarrassment and alarming dyspnea.

Perihilar bronchopneumonic infiltration, when bilateral, may occupy the wings of the chest, or it may approach the apex in one and the base in the other lung; there may be a protrusion of the middle intermammary region. This disfigurement is called annular emphysema. There is a greater tendency in this type to fibrosis and chronicity than in the purely apical variety. The prognosis is more serious in the cavitary forms and *cæteris paribris*, the younger the age of the patient; when the foci are small and disconnected, the prospect is brighter than when continuous tracts of infiltration are visible on the radiogram. In the strictly unilateral forms the outlook is also more favorable. This essentially chronic type appears to be more closely connected with the flat chest, whether congenital or acquired, which, when it becomes emphysematous still remains practically flat, bulging, if at all, merely in the lower middle and basal parts of the lung. —*Perihilar Bronchopneumonic Pseudolobar Phthisis, W. Overend, Arch. Radiol. & Electrother., January, 1920.*

Tuberculosis of the Breast.—The syndrome affects only one breast and is more common in females, especially in mature patients who have nursed children. About one-half of the cases are probably retrograde infections from the axillary glands, which are always involved either primarily or secondarily. Others may be hematogenic or from contiguous structures. Often the primary focus is undiscoverable. In the case reported there was no family history nor any primary lesion antedating the breast process. Five years previously the patient noticed a small breast nodule, firm and painless. This grew larger, others appeared and later there was a discharge of thick material, accompanied by intermittent fever. The woman was slightly emaciated, with a sallow skin, a temperature of 102 and a pulse of 120. The breast was shrunken and discharged thin pus from several sinuses near the nipple. The axillary lymph nodes were enlarged. The blood showed a moderate secondary anaemia. The general examination was otherwise negative. The entire breast was removed with the overlying skin and the axillary lymph nodes. The specimen shewed confluent tuberculosis.—*Tuberculosis of the Breast—Report of Case, C. Rosser, Dallas M. J., April, 1920, 16.*

Tuberculous Enterocolitis.—The pathology of tuberculosis of the intestine is divided into three types: (1) nodular, (2) ulcerative, and (3) fibrous. A lesion roentgenologically demonstrated in the ileocecal coil, with irregularity of bowel contour and without the physiologic barium shadow in the cecocolon, although it may represent any ulcerative process, is probably tuberculous if pulmonary tuberculosis is present. The various types are usually associated to a greater or less extent, dependent on the stage of the disease. The nodular type is recognized by means of the roentgen ray only if it encroaches on the lumen of the bowel, and the ulcerative and fibrous types by irregularity of contour, and in the terminal stages by obstruction. The presence of spasm must not be overlooked, since it often causes irregularity of contour and is diagnostic even when the lesion itself is not demonstrable. The opaque enema generally is preferable to

the ingested meal in demonstrating the filling defect and spastic phenomena which are roentgenologic signs of tuberculous colitis. A gap in the physiologic barium shadow of the cecocolon in the more advanced cases is demonstrated by the ingested meal, but unquestionably the disease will be demonstrated earlier by the enema.—*Roentgenology of Tuberculous Enterocolitis, R. D. Carman, J. Am. M. Ass., May 15, 1920, lxxiv, 1371.*

Tuberculosis of the Mesenteric Glands.—Primary tuberculosis of the mesenteric glands is not so well known as the secondary form, in spite of its greater importance. The diagnosis of the primary form is important because it is so often confused with surgical diseases, especially appendicitis. The disease is produced by tubercle bacilli entering from the intestine. The bovine type of bacillus is common. The favorite site of the disease is the lymph glands of the ileocecal region. Children are more frequently affected than adults, which is owing to the greater permeability of the intestinal mucosa. Abdominal pains, usually localized in the ileocecal region, are the most important initial symptom. Acute symptoms often resemble those of tuberculosis of the peritoneum. Fever is usually present at the onset. Insatiable hunger (bulimia) and denutrition, accompanied by secondary anemia, are characteristic symptoms. The intestinal disturbances vary and are not typical. Blood in the stool points rather to tuberculosis of the intestine. Two roentgenograms of the abdomen should be taken several days apart for purposes of comparison. The most important clinical complication is ileus. The lack of abdominal distention and the abdominal sensitiveness to pressure help to differentiate the disease from appendicitis, which it resembles in its earlier manifestations. Tuberculosis of the mesenteric glands is more amenable to treatment than any other form of tuberculosis: forced feeding, change of climate, artificial heliotherapy, deep abdominal roentgenotherapy, and tuberculin injections. Surgical intervention is indicated only when long continued internal treatment has failed. Mesenteric abscesses may demand an operation. Various types of operation are to be considered: radical extirpation of the diseased glands, excochleation, abscess puncture and explorative laparotomy in diffuse conditions in which assailable glands are not readily recognized.—*Die Mesenterialdrüsen Tuberkulose, E. Gehrels, Deutsche med. Wchnschr., October 9, 1919, xlv, 1128.*

Tuberculosis of the Appendix.—Tuberculous appendicitis is a definite entity which, though rare, should be considered in both diagnosis and prognosis and surely justifies routine sectioning and careful examination of all appendices removed at operation. Demonstration of the lesion may save many lives either by removal of the primary focus or by making a diagnosis so early that immediate treatment may bring about arrest or cure of the general conditions.

Conclusions: (1) The disease may be primary or secondary. (2) Infection occurs directly from the intestinal contents or by the hematogenous or lymphatic route. (3) It may produce either the ulcerative, hyperplastic, or miliary type. (4) It can frequently be diagnosed only by microscopic examination. (5) The symptoms resemble very closely those of suppurative appendicitis.—*Tuberculosis of the Appendix, Margaret Warwick, Ann. Surg., February, 1920, lxxi, 139.*

Tuberculosis of the Urinary System.—Renal tuberculosis is insidious in its onset and is secondary to a focus elsewhere. The infection is hematogenous in its origin, is carried upward by means of the lymphatics, downward by the urine. The ureter and bladder become diseased by a descending infection. Tubercle bacilli should be found in the urine. The presence and function of the second kidney must be determined. The treatment consists of nephrectomy followed by injections of tuberculin, together with general antituberculosis treatment. Healing of a tuberculous lesion in a kidney is very doubtful; the disease almost invariably progresses till the whole organ has been destroyed.—*Tuberculosis of the Urinary System, J. E. Palmer, Can. M. Ass. J., March, 1920, x, 225.*

Prophylaxis of Renal Tuberculosis.—Renal tuberculosis is widely prevalent and almost always escapes detection, at least during the period when a nephrectomy offers the greatest chance of success. It is an essentially chronic disease, and may develop insidiously with periods of remission. One patient was inoperable from bilateral pyonephrosis when first seen, but is still under observation ten years later. The first, the albuminuric phase, is followed by the pyuric phase, with or without slight symptoms from the bladder. The involvement of the bladder forms the third phase. Usually it is only after the practitioner has wasted some time trying to cure the "cystitis," that he thinks of the kidney and calls in a surgeon, just before the fatal progression into the fourth, the terminal stage. Renal tuberculosis is of blood-borne origin. Every young person with albumin and pus or blood in the urine (not explainable by gonorrhea or other infectious disease or adnexitis), should be suspected of renal tuberculosis even although the general condition is good. Note

the transparency of the urine, the tender points for the kidney, palpating for them with the hands superposed, working from above downward and from within outward along the line from the umbilicus to the thigh, following the pulsation of the iliac artery down to the passage of the ureter into the superior strait of the pelvis. An absolute diagnosis is possible only with discovery of the tubercle bacillus, and, with this, the surgeon should be called in at once. Krönlein found a tuberculous process in the kidney in 29.8 per cent of the cadavers examined, and all authors agree that renal tuberculosis is unilateral in the first stages in 88 per cent of the cases at least. By the time severe cystitis has developed, both kidneys are usually involved.—*Di alcuni rilievi clinici per la lotta contra la tubercolosi renale, D. Taddei, Rif. Med., November 29, 1919, xxxv, 1056.*

Massive Degeneration in Tuberculosis of the Kidney and Clinical Cure.—In kidney tuberculosis the lesions may be of such minor intensity and virulence that they heal without ever becoming clinically manifest. At the other extreme are those rare cases which pass on to complete destruction, isolation and so called self-enucleation. This is compatible with our knowledge of tuberculosis as it affects other organs of the body. Closed tuberculosis of the kidney may result either from obliteration of the ureter preventing the kidney from emptying its pathological products into the lower urinary tract, or from the destruction of the kidney secretory tissue, perhaps combined with an obliterating ureteral lesion. The latter group is the so called silent kidney, representing an autonephrectomy. Two cases are reported in this group. In one case the patient died of pernicious anemia, without any symptoms referable to the renal lesion. Autopsy showed the secretory tissue of the kidney to be entirely destroyed and replaced by a mass of caseous material. No tubercle bacilli and no tubercle formations were present, so that the lesion may be regarded as entirely inactive and healed. In the other case, the kidney was obtained by nephrectomy: although the secretory tissue was destroyed, and clinical symptoms had abated, the kidney represented one stage through which the case must have passed and the condition was not entirely healed.—*Massive Degeneration in Tuberculosis of the Kidney and its Rôle in the Clinical Cure, A. Randall, J. Urol., December, 1919, iii, 427.*

Monobloc's Operative Treatment of Tuberculous Lymphangitis.—Although the treatment of tuberculous lymphangitis by the excision of the primary focus, the affected vessels and the glands of which they are afferents, is recognized as perhaps the only effective treatment for tuberculous lymphangitis of the limbs, Handley doubts whether the importance of excising all the affected tissues in one piece has been properly emphasized. Obviously, if the removal is carried out in sections, the chances of a reinfection of the wound are greatly increased. He cites a case of tuberculous lymphangitis following injury to a tuberculous wart of long standing in which the result was not perfect, and the policy of attacking the recurrences, which sometimes gives such satisfactory results in carcinoma was followed with a considerable degree of success. From the microscopic examination of many specimens, Handley is convinced that lupus vulgaris is essentially and primarily itself a lymphangitis of the cutaneous and subcutaneous lymphatics, and that it differs from "tuberculous lymphangitis" only in its slow and limited spread through the lymphatics. The principal reasons for this belief are: The plane primarily affected, namely, the superficial layer of the dermis, is the plane of origin of the lymphatic vessels of the skin. Changes in the lymphatic vessels of origin can be seen beyond the clinical edge of the area of lupus. Moreover, isolated giant cell systems can often be found in the subcutaneous tissue, showing that this layer also is affected as well as the skin, and these isolated giant cell systems are usually found close to the blood vessels, in the situation of the comitant lymphatics.—*Monobloc's Operative Treatment of Tuberculous Lymphangitis, W. J. Handley, Brit. J. Surg., January, 1920, vii, 324.*

Tuberculous Rheumatism.—While the existence of tuberculous rheumatism is quite generally recognized, there are many erroneous ideas afloat in regard to the nature of the disease and with respect to its treatment. Many seem to think of tuberculous rheumatism as an articular localization of the Koch bacillus which is not only still unproved but seems to be in contradiction with almost all the facts. It should therefore be emphasized that tuberculous rheumatism (or inflammatory tuberculosis) presents just ordinary lesions, and that there are no evidences of classic tuberculosis. Tuberculous rheumatism is not so much a toxic rheumatism as an antitoxic or reactional rheumatism. It seldom appears when the toxic substances are abundant. The tuberculous rheumatic is one who has recovered from tuberculosis, whose organism is defending itself, and in whom the antibodies are very active and very abundant. Since tuberculous rheumatism is not a local tuberculosis but a rheumatism, it should be treated like other forms of

rheumatism: warmth, immobilization during the acute stages but mobilization and massage as early as possible to avoid atrophy and ankylosis.—*Rhumatisme tuberculeux, L. Duvernay, Lyons Méd., April 10, 1920, cxxix, 298.*

Uncinariasis and Manifest Tuberculosis.—In forty-six cases of suspected tuberculosis, Adams failed to find any evidence justifying the diagnosis of tuberculosis but established the presence of existing infection with hookworm in thirty-two cases, and developed clear histories of previous infections of considerable severity in the remaining fourteen cases. The provisional diagnosis had been made in each instance chiefly because of the presence of adventitious sounds over the upper chest. Investigation disclosed the entire absence of râles and demonstrated the presence of joint sounds ranging from coarse grating to fine crepitations, the latter distinguished only with difficulty from true râles. The majority of these sounds are to be heard over the sternocostal articulations and are transmitted out to the ribs, especially in the vicinity of the clavicle. A comparative study, on one hand, of 100 individuals with clinical evidence of uncinariasis, and of 100 normal subjects, on the other, showed a preponderance of confusing crepitations of about three to one in favor of the former. In old cases of hookworm infection the adventitious joint sounds are not confined to the shoulder girdle and adjacent parts, but are to be heard over several or many of the articulations. In Adams's opinion there is no evidence establishing any specific relationship between the two diseases, and, inasmuch as it has been demonstrated that the mortality from tuberculosis may be reduced by a measure so simple as elimination of hookworm where double infection exists, the obligation of the physician with regard to diagnosis and treatment is apparent.—*Uncinariasis and Manifest Tuberculosis, R. D. Adams, South. M. J., February, 1920, xii, 105.*

Tuberculous Lesions in Temporal Bone.—Bellin and his co-workers have encountered four types of tuberculous osteitis in the temporal region and ear, and cite a fifth type described by Bernard. They give an illustrated description of a case in each type: (1) latent tuberculous mastoiditis, often revealed by deafness; (2) tuberculous mastoiditis with necrosis, sometimes revealed by facial paralysis; (3) the same with fistulas; (4) chronic osteitis of the middle ear with hyperostosis of the mastoid; and (5) osteitis of the auditory meatus of of the scala tympani. The cases reported terminated fatally, the mastoid lesion being usually accompanied with tuberculous lesions elsewhere. The only exception is a case in which the outcome is not known although the immediate results of a radical operation were good. The lesion seemed to be limited to the external meatus and scala tympani, except where the condyle of the lower jaw had been touched by the osteitis. As a general rule, reliance must be on general measures until we can learn to detect these processes in their incipiency and remove the focus before there is extensive destruction.—*Ostéite tuberculeuse du temporal et des cavités annexes de l'oreille, Bellin, Aloin & Vernet, J. de Chirurg., December, 1919, xv, 486.*

High Frequency Treatment in Tuberculous Osteitis.—Four cases of tuberculous osteitis had been recorded some years ago, as having recovered under high frequency treatment. Three cases have remained well after intervals of eight, seven and six years respectively, while one showed recurrence three years after apparent cure. Since 1912 the author has used the method in about twenty cases of various types. The voltage employed always exceeded 80,000, and the frequency of current oscillations varied from 800,000 to one million a second. Ten minute treatments were given daily or three times a week. Results in tuberculous osteitis of the foot were particularly encouraging. Great variation in the duration of treatment required was noted, however, some patients recovering in a few weeks, and one in eighteen months. The high frequency treatment acts only with difficulty on deep seated tissues, and in general the deeper the lesions, the slower the effects. Yet the treatment failed in one case of tuberculosis of the wrist and in a case of spina ventosa. Hence success in the treatment would appear not to depend solely upon the depth of the diseased tissue, but also upon some other factor—possibly the habitual temperature of the parts, the hand, for example, being continuously exposed to a low temperature and thus lending itself less well than other parts to defense of the tissues against infection and to the processes of tissue repair. On the whole, however, the results from the treatment were sufficient to warrant its general employment.—*Traitement des ostéites tuberculeuses par les courants de haute fréquence et de haute tension, M. Doumer, Bull. d. l'Acad. d. Méd., January 27, 1920, lxxxiii, 93.*

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Tuberculosis in Childhood. — The proper treatment of tuberculous infection in childhood is becoming recognized as one of the most important means of preventing the development of tuberculosis in adult life. In an article in a recent issue of *The Commonhealth*, Dr. H. D. Chadwick, Superintendent of the Westfield Sanatorium, has considered the problem of tuberculosis in childhood, emphasizing the difference between early infection and disease, and outlining the symptoms and effective methods of treatment.

Tuberculosis is one of the common diseases of childhood, too often neglected and allowed to remain as a focus for later pulmonary development. In infancy the infection is a generalized disease; in childhood it appears in glandular form; and adult tuberculosis develops as a later stage of the glandular and peribronchial disease in children. During various age periods the body reacts differently to the infection: an infant infected with tubercle bacilli develops general miliary disease; older children acquire the power of reacting to infection, with a result that localization of the bacillus occurs, most often in the lymphatic glands, or more rarely in the bones. Resistance to further pathological development depends on many things, among which unhealthy living conditions in the home and school, subjecting the child to other diseases and lower vitality, is one of the most important and yet a preventable factor. Before children reach the age of sixteen years, nearly all of them have become potentially tuberculous by the entrance into their bodies of tubercle bacilli, which in the majority of instances remain latent through life unless the infection is awakened into activity either by environmental conditions or some intercurrent disease. When symptoms begin to appear, children should be observed carefully as they are less apt to complain than are adults and their first symptoms are chiefly subjective. In any case where there is no complete diagnosis, tuberculosis should be considered either as the primary cause of other symptoms or as a smouldering secondary condition. Children who have been exposed for a prolonged period to an active case of pulmonary tuberculosis will almost certainly become infected; they will develop symptoms of tuberculosis later if they are poorly nourished or become debilitated by some other disease. The symptoms vary with the location of the tubercle and with the amount of local reaction set up by the presence of bacilli. In nearly all children the infection at first is localized in the bronchial glands and about the root of the lung. If the disease develops the child becomes listless and unduly fatigued, has little appe-

tite, and usually develops in the late afternoon a temperature one-half to one degree above normal. He will often appear irritable and dull, and will fail to develop normally in height and weight. A cough may begin when enough peribronchial irritation develops, either from inflammation or pressure, and vague transitory pains in the legs and body may be complained of. The symptoms of childhood tuberculosis in the early stage are those of toxemia resulting from tuberculous absorption; there may be no cough, and symptoms indicating the focus of the disease may be absent. The symptoms of fever and fatigue depend to a great extent upon the activity of the child. Greater importance should be attached to symptoms than to physical signs. Weakness is the most constant of the warning symptoms. It has been found that children having symptoms of active tuberculosis respond to sanatorium treatment if they are reached before the tubercle has broken down and the lesion has become an open one. In advanced cases where the sputum is positive, the prognosis is not as good as in adults at a corresponding stage of the disease, even when the best conditions for treatment are available. Tuberculous children need frequent rest intervals, with short periods of study and play and frequent change of activity and rest. Fresh air is essential, but too much cold air, taking away too much bodily heat, may only further depress a patient and enfeeble his resistance.

It should be remembered that tubercle bacilli are omnipresent and that all children are susceptible to infection. Although nearly all become infected, only a small percentage develop the symptoms of disease during childhood. The pulmonary disease of adults, however, is generally due to the lighting up of the tuberculous focus which has been quiescent since childhood. How important it is, then, in preventing the development of pulmonary tuberculosis in an adult, to treat that individual when the infection first appears in childhood, doing everything possible to increase resistance and to create a reserve at an early age by improving personal hygiene and home conditions. Although it is probable that childhood infection makes more difficult additional infection from without in later life, an adult whose vitality is lowered is in constant danger from the infection which he has carried in his tissues since early life. Although little can be done in preventing infection, improved conditions in the homes and schools will accomplish a great deal in preventing the child from becoming diseased. Resistance built up in childhood will be of benefit to the adult.—*Editorial, Boston M. & S.J., June 24, 1920, clxxxii, 665.*

Tuberculosis of the Spine.—Operative measures are useless and harmful in the early stages of Pott's disease in children. On the other hand, they are directly indicated in adults in the same conditions, as adults do not possess the faculty of spontaneous complete recovery which is peculiar to childhood. Orthopedic treatment with immobilization for three or four years results in complete consolidation in children, but the adult spine requires support as it never regains its full strength. The child with Pott's disease should be given general treatment for tuberculosis as well as the local orthopedic treatment. The organization of enough sanatoriums to allow this is the solution of the problem. For adults, the slight tendency to destructive processes and the lack of compensating processes are further reasons for reinforcing the spine by a grafting operation. Calvé gives an illustrated description of his modification of the Hibbs technic. He makes a bed for the implant by cutting out the spinous process, leaving a right-angled cavity. Then he slits the lamina to each side, to the base of the transverse process, and turns back the piece thus pried up. This leaves a long, large freshened bed in the diseased vertebrae and in the sound vertebrae above and below. This gives a solid hold for the implant. The spinous processes resected are cut up into small pieces and are scattered along the whole length of the graft. This does away with the objections to the ordinary Hibbs method, which seems to be better adapted than the Albee method to the dorsal region. Lower than this, the Albee technic has given fine results in his hands. The article is illustrated.—*Quelques généralités sur le traitement du mal de Pott et sur l'opportunité de l'osteosynthèse, methodes de Hibbs et d'Albee, J. Calvé, Presse Méd., January 7, 1920, xxviii, 13.*

Treatment of Tuberculosis of the Spine.—Immobilization of the diseased area in tuberculous spondylitis is the immediate aim sought by both conservative and surgical methods of treatment. Since tuberculosis of the spine is always secondary to tuberculosis of some other part of the body, general hygienic care, fresh air and sunshine are paramount in both modes of procedure. The very young and those adults who present formidable complications are treated conservatively, e.g., by recumbency, rest, hygiene, heliotherapy, Bradford frame for usually six months, followed by plaster cast to further fixation in extension, and finally by a Taylor spinal brace. The Calot jacket and the suspension jury masts are indicated in the cervical and upper dorsal cases. A properly applied jacket allows breathing

space, hyperextends the spine and supports the weight above the necrotic area. The Hibbs and Albee fusion operations, bringing about immobilization, shorten the period of recumbency to usually six weeks as against six months to one year in the conservative procedure. The Hibbs method results in the construction of a periosteal tube filled with the fractured spinous processes and the freshened ends of the laminae, from which spiculae of bone are chiseled and bridged to the neighboring lamina. Union results practically always. The Albee grafting operation consists in removing a long section of bone preferably from the tibia and placing it in the split spinous processes, so as to bridge the diseased area well above and below. Of the 405 cases of Pott's disease observed at the Mayo Clinic (1912–1918) 100 were operated by a modified Albee method, namely excision of a curved graft from the tibia to fit the spinal deformity. The ages of the operated cases ranged from one year to sixty years. Fifty-six per cent and 19 per cent were of the ages twenty-one to thirty and thirty-one to forty respectively. Sixty-five per cent were males. Duration of the symptoms ranged from less than one year to five years. One patient had symptoms for nineteen years. Twenty-two per cent gave a history of trauma to the area involved. Twenty-seven per cent had symptoms of tuberculosis in other organs before onset. Paraplegia was present in 7 per cent and was not considered a contraindication to operation. The disease process was located in high dorsal region in 2 per cent; in mid-dorsal in 14 per cent; in low dorsal in 27 per cent; in dorso lumbar in 11 per cent; in lumbar in 46 per cent. Previous conservative treatment in these cases with casts and braces had been unsatisfactory. In 3 cases bone grafting has been done elsewhere. The duration of recumbency following operation was determined by the patient's relief and desire to move, by the normal temperature, by freedom from pain and muscle spasm and finally by the degree of calcification and union as revealed by the X-ray. In most cases the patients had a cast or brace applied while still in bed and were allowed to become gradually accustomed to the upright position on a back rest. They were up in 6 weeks. Within a few days walking was permitted, but the patient was cautioned against removing the brace unless in recumbency. In the cases treated conservatively the period of recumbency with hyperextension was usually one year. The importance of general hygiene, heliotherapy and immobilization was impressed upon the relatives. The result of treatment was interpreted in terms of improvement of the pain and of the disability, irrespective of the deformity and even evidence of psoas abscess. Eighty-six per cent of the patients of this series have been relieved. Eight patients died of generalized tuberculosis from one and one-half to three years after the operation.—*Treatment of Tuberculosis of the Spine, H. W. Meyerding, Minn. Med., May, 1920, iii.*

Diagnosis of Tuberculous Meningitis in Children. Rominger comments on the tendency to regard tuberculous meningitis as a distinct disease, whereas it is important to bear in mind that it is in reality only one aspect of general miliary tuberculosis, and that the condition of the other organs, especially the lungs, may offer valuable evidence for an early diagnosis. Although tuberculous meningitis is usually easily recognized if there are pronounced brain symptoms, yet in the beginning of the disease, as long as only dubious general nerve symptoms are present, diagnosis is often difficult. Even when meningitis is diagnosed, it is often difficult to ascertain what form of meningitis is present. Roentgenograms of the lungs should be made, and they are often valuable, especially if the lungs already show signs of miliary tubercles, but negative results do not by any means exclude tuberculous meningitis, as miliary tubercles in the lungs often develop late, sometimes only shortly before death. Lumbar puncture is instructive. The tubercle bacillus is found in only from 80 to 90 per cent of the cases and often requires several days of patient search. Lymphocytosis can only be regarded as a possible indication. Increased pressure as shown by lumbar puncture is important, but more valuable still is evidence of an increased albumin content of the cerebrospinal fluid, for which Pándy's reaction is the most reliable and practical method. This consists in adding a drop of cerebrospinal fluid to 1 cmm. of 1 to 15 phenol solution. Cloudiness at the zone of contact is a sign that the fluid contains easily precipitable albuminous substances in pathologic quantities. In a series of fifteen cases the Pándy reaction was positive.—*Zur Diagnose der tuberkulösen Meningitis im Kindesalter, E. Rominger, Münch. med. Wchnschr., November 28, 1919, lxvi, 1381.*

Concentrating Sputum.—The Greenfield and Anderson method is modified by adding sodium carbonate directly to the sputum in graduated sputum flasks. This is incubated over night and smears are made after centrifugating the supernatant fluid. The bacilli show very well in the stained smears. The method is superior to that of

Ellermann and Erlandsen.—*A Simple Technic for Concentrating Sputum, J. Woolley, J. Am. M. Ass., February 21, 1920, xxiv, 525.*

Bacteriologic Characteristics of Tubercle Bacilli from Different Kinds of Human Tuberculosis.—The main objects of Griffith's investigations were (1) to determine by the examination of unselected cases the relative proportions of the human and bovine types of tubercle bacilli in different kinds of human tuberculosis, and (2) to ascertain the frequency of occurrence and the distribution in the human body of variant strains of tubercle bacilli. Of 1068 persons examined, 803 showed human bacillus infection, 194 bovine bacillus infection and five a mixed infection. Of various regions involved, the examination showed that bovine infections occurred as follows: Bones and joints, 19.7 per cent; genito-urinary organs, 17.65 per cent; cervical glands, 46.3 per cent; meninges, 20 per cent; scrofuloderma, 34.65 per cent; lupus, 48.9 per cent. As to the age periods, bovine infection occurred as follows: during first five years of life, 37.55 per cent; from five to ten years, 29.45 per cent; from ten to sixteen years, 14.66 per cent; after sixteen, 6.25 per cent.—*The Bacteriological Characteristics of Tubercle Bacilli from Different Kinds of Human Tuberculosis, H. S. Griffith, J. Pathol. and Bacteriol., February, 1920, xxiii, 129.*

Bacteriology of Urine in Renal Tuberculosis.—The results of observations in sixty-three cases of renal tuberculosis are reported. In all the diagnosis has been proved either by finding the tubercle bacillus in the urine, by operation, or at necropsy. Cultures from the bladder were made in 30 cases with 15 positive results, in 10 of which the symptoms dated anywhere from one to ten years. Cultures of the right kidney urine were made 31 times with 7 positive results, and 28 times from the left kidney with 6 positive results. In these, as in the bladder urines, the colon bacillus was most commonly found. It will be observed that whereas in the bladder urine the cultures were positive in 50 per cent, in the kidney urines positive results were obtained in but 22 per cent, indicating a greater ability of the kidney to remain aseptic than the bladder. This statement is somewhat modified by the fact that of the 13 positive cultures from the kidney, 8 were on the healthy side and only 5 on the tuberculous side. Smears of the bladder urine showed secondary infections in 21 cases. Smears from the kidney urines were made in all cases in which it was possible to catheterize the ureter. Secondary organisms were found in only 5 instances. Combining the results of cultures and smears from the separate kidney urines, it is found that positive results were obtained on the healthy side in 11 cases, and on the tuberculous side in 7: a total of 28.5 per cent of secondary infection of the kidney urine in 63 cases. That the reaction of tuberculous urine in and of itself is not hostile to the growth of the colon bacillus is shown by the clinical data (in one kidney large numbers of tubercle and colon bacilli were found in the same smear). The authors have also found that, after examination, specimens of tuberculous urine which have been left standing in the laboratory often show a profuse growth of organisms from accidental contamination. On the whole these results show conclusively that while a negative smear or culture from the bladder in a case of cystitis and pyuria points strongly to tuberculosis, a positive smear or culture from the bladder, or even from the kidney urine, does not exclude this disease.—*The Bacteriology of Urine in Renal Tuberculosis, J. D. Barney & E. S. Welles, J. Am. M. Ass., May 29, 1920, lxxiv, 1499.*

Complement Fixation in Leprosy.—In a study of 20 cases of leprosy of the nodular, macular, nerve and mixed types, Cooke found that leper serums contain complement binding substances that react with antigens of acid fast bacilli and give an acid fast fixation similar to that obtained with serums of rabbits immunized with acid fast organisms. Some serums contain these antibodies in rather high concentration, notably those from cases of the nodular type of the disease. Other serums show a relatively low antibody content. The serums of high titer may also give a nonspecific fixation with nonacid fast antigens and with lipoidal (Wassermann) antigen, but only in comparatively low dilutions. It is suggested that this attribute of such high titer leper serums may explain a certain percentage of positive Wassermann reactions described in leprosy. The acid fast reaction given by leper serums with acid fast bacterial antigens prevents the use of the complement fixation reaction in obtaining evidence of the etiologic importance of any acid fast organism isolated from leprosy.—*Complement Fixation with Acid Fast Bacteria. II. Leprosy, J. V. Cooke, J. Inf. Dis., December, 1919, xxv, 474.*

Complement Fixation. — Thirty-six cases of suspected tuberculosis were tested. Twenty patients, or 55.5 per cent, gave a positive reaction. There were 8 positive Wassermanns and 6 clinically diagnosed as having syphilis and tuberculosis. Of 69

cases with diagnosis other than tuberculosis, 12, or 17.3 per cent, gave positive complement fixation tests. Of the 69 cases, 1 in every 5.7 gave a positive complement fixation reaction and 1 in every 8.6 gave a positive Wassermann. Buddy points out that the complement fixation test for tuberculosis is of some value in the cases of positive tuberculosis. A negative reaction in this class usually indicates far advancement with very grave prognosis. It has a clinical value as additional evidence in clinically active tuberculosis. In suspected cases it has a slight value only in being an additional factor for or against tuberculosis. A diagnosis of clinical tuberculosis cannot be made from a positive reaction, neither can tuberculosis be excluded from negative reaction. It is not of so much value in tuberculosis as the Wassermann reaction is in syphilis. It is an aid only when considered in conjunction with complete history and thorough physical examination.—*Clinical Value of Complement Fixation Test for Tuberculosis, P. Buddy, Miss. State M. Ass. J., April, 1920, xvii, 145.*

Complement Fixation.—This test can never determine positively whether or not a patient is ill with tuberculosis. On the other hand, the results of the test are in fairly close harmony with the true condition of the patients who have been tested, and hence it should influence judgment in arriving at a diagnosis. This test should not displace clinical observations, but if properly used it will stimulate the clinician to make more accurate and thorough observations.—*Interpretation of Complement Fixation Reaction in Tuberculosis, G. Ives, Miss. State M. Ass. J., April, 1920, xvii, 147.*

Complement Fixation.—It has been stated that clinical activity, as well as the immediate prognosis, can be determined by means of this test, with unprecedented accuracy. To test the validity of these assertions, the complement fixation test was performed in 700 consecutive cases admitted to the Bedford Hills Sanatorium, New York. The object was to ascertain the diagnostic value of the test, the activity of the process when a diagnosis has been made, the relative value of the test in the different stages of the disease, and its prognostic value. Miller's bacillary suspension and a similar antigen prepared by the Board of Health of New York City were used. In this series, 24 per cent of nontuberculous individuals and only 52.4 per cent of definitely tuberculous gave a positive reaction. It would therefore seem hazardous to permit the test in its present stage of development to influence our clinical judgment. The test did not help in the differential diagnosis of pulmonary diseases. In pulmonary tuberculosis, clinical activity could not be diagnosticated from the results of the complement fixation test. The test shed no light on immediate prognosis. No tendency to cross fixation with a Wassermann reaction really exists. The percentage of positive reactions increased as the disease advanced. The percentage of positive reactions in definitely incipient tuberculosis in this series was only 33 per cent. Where the test could be of greatest assistance, it is least applicable.—*The Tuberculosis Complement Fixation Test; Report of 700 Cases, B. Stivelman, J. Lab. & Clin. Med., April, 1920, v, 453.*

Complement Fixation.—A series of complement fixation tests with serums from patients with tuberculosis was made using a number of acid fast bacterial antigens, together with similar tests in syphilis and a variety of other diseases. The concentration of the complement fixing antibodies was studied by titration. The reaction is not specific for the tubercle bacillus, but for a group of acid fast organisms, which also includes a pigmented and a nonpigmented leprosy strain and a purely saprophytic organism like the smegma bacillus. The reaction was negative with a nonacid fast diphtheroid bacillus. The tubercle bacillus in all tests appeared to give one of the best acid fast antigens. With it in 11 cases of outspoken tuberculosis positive fixation was obtained in 90 per cent, as also in 2 out of 6 cases of suspected tuberculosis, whereas 5 cases of healed pulmonary lesions were negative. A relatively small percentage of patients with active tuberculosis have too small an amount of complement-fixing antibody to be recognized in the test, analogous to those cases of syphilis that give a negative Wassermann. In fifty cases of syphilis all of which gave a strongly positive Wassermann test five showed acid fast fixation, a proportion slightly larger than the 5 positive cases of a group of 73 tests on persons with other diseases. In the preparation of the antigens it was found that those strains of the organisms used that gave the most even suspension furnished the best antigen. The amount of antigen used is of importance, since large amounts tend to give nonspecific fixation; this is especially true of syphilitic serums. The proper antigen dose may be determined by preliminary titrations with several serums. A control should also be included with a simple lipoid antigen. No relation could be shown between the titer of a serum and the clinical severity of the infection, but serums with a titer of less than 0.1

cc. are practically always from cases not clinically active. Leprosy and tuberculosis are the only human infections that give the reaction, so that it is specific for the acid fast group of bacteria, and may appropriately be termed acid fast fixation.—*Complement Fixation with Acid Fast Bacteria; III. in Tuberculosis, J. V. Cooke, J. Inf. Dis., December, 1919, xxv, 493.*

The Roentgen Ray and Tuberculosis.—It has been rather definitely shown that the lymphatic tissues, spleen, lymph nodes, and bone marrow are the ones which suffer principally after exposure to the X-ray, and there is a certain amount of evidence that the lymphocytes are the cells which are most active in protecting the body against tuberculous infection. On these theories it is easy to conclude that the use of the X-ray in the presence of tuberculous infection is strongly contraindicated. Such a conclusion was supported by the work of Morton, who found that guinea pigs that had received intraperitoneal injections of urine containing tubercle bacilli succumbed to the disease in a much shorter time when they were exposed to massive doses of the X-ray shortly after the inoculation. Morton's work seemed to be in harmony with that of Murphy, who studied the effect of the X-ray upon the lymphocytes. But much evidence soon began to appear on the opposite side of the subject. Lewis and Margot found that white mice that had been subjected to splenectomy showed increased resistance to the development of tuberculosis after inoculation, and it has recently been announced that the roentgen ray offers a hopeful method of treatment of tuberculous adenitis. It has apparently been shown quite clearly that antibody formation is interfered with by exposure to these rays, for Hektoen's work in this direction has not been successfully controverted, but the subject is still in a chaotic condition.

Recently Weinberg has attempted to reproduce Morton's results. In this he has been unsuccessful and reports that exposure to the X-ray has but little effect upon guinea pigs that have been inoculated with the tubercle bacillus (*Archiv. Int. Med.*, 1920, xxv, 565). It is impossible to reconcile the findings of these two investigators and the question must be settled by further studies. Weinberg found the same systemic response to the X-ray as other students have seen. There was a consistent drop in the white cell count, the number of lymphocytes being especially reduced. On microscopic examination he found that in the roentgenized animals there were fewer polymorphonuclear leucocytes and lymphocytes in the blood vessels and there were very few lymphocytes in the outer zone of the tuberculous lesions. The problem is an exceedingly important one in its practical bearing upon therapy, and it is hoped that early investigation will be successful in clearing up some of the obscurity which now surrounds it.—*Editorial, Med. Rec., June 19, 1920, xcvii, 1046.*

Tuberculosis in 1920, a Review.—Prophylaxis and hygiene rather than the medical aspect of tuberculosis engrossed attention during 1919. Among the few communications on the medical features were those on the detection of the falsely labeled tuberculous. Compulsory declaration of tuberculosis seems to have been postponed to the day when the declaration will ensure care and assistance for the tuberculous and his family. Until this can be realized, notification serves merely to pile up statistics. E. Sergent has recently presented evidence that even tubercle bacilli in the sputum do not necessarily prove that the lesions are in process of evolution, and also that the absence of tubercle bacilli is not unfailing testimony as to the nonactivity of the lesions. Radiography throws no light on the age and evolution of the lesions, but a low arterial pressure is the rule in progressing cases. A rise in temperature after muscular exercise does not necessarily mean tuberculosis, as unstable temperature may be observed under various other conditions, digestive, cardiac, etc. Sergent's dictum holds good that there is no absolutely certain sign which tells whether the tuberculous process in a well appearing person is progressing or not. He may have had hemoptysis on one occasion or a disquieting pleurisy, but has been in apparent health since. Repeated examination, the fixity of the stethoscopic and radioscopic findings, the character of the physical signs, the attenuation of the myotonic reaction, the disappearance of the tenderness at the apex, the normal blood pressure, the intensity of the tuberculin reaction, stability of the temperature, and the repeatedly verified absence of tubercle bacilli from the sputum, form a bundle of proofs on which the diagnosis can be based. The whole secrêt lies in repeating the examinations and comparing the findings. About 25 per cent of the tuberculous show roentgen shadows in the fissures between the lobes, but few physicians ever examine for these *localisations scissurales*, and yet they are an important factor in recurring pleurisy. The stethoscope reveals small and inconstant foci of dry rattling, or friction râles, which, associated with intercostal neuralgia and cough, aid in detecting these frequent and benign tuberculous

lesions. Roger demonstrated ten years ago that the absence of albumin from the sputum excluded tuberculosis. A positive albumin reaction is found in many other diseases, but Krongold has recently published evidence to the effect that the presence of peptone in the sputum is a reliable sign of tuberculosis, as the tubercle bacilli belong to the small group of microörganisms which by their proteolytic ferments split albumin into albumoses and peptones. Jousset insists that tuberculosis, as we know it, is merely the nodular form of infection by the tubercle bacillus. The latter may induce a wide range of reactions and symptoms, and in both there is first an acute, curable, congestive stage, in which serotherapy is promising. The most important work on artificial pneumothorax during 1919 is stated to be that by Morelli of Montevideo. He draws the balance sheet with a most favorable balance to the credit of the procedure in appropriate cases. Lalesque's review of his thirty years of treatment of tuberculosis at a seashore sanatorium is said to be another instructive contribution. He emphasizes the importance of the moisture of the sea air in preventing congestion and hemoptysis.—*La tuberculose en 1920 (revue annuelle), P. Lereboullet & L. Petit, Paris Méd., January 3, 1920, x, 1.*

Tuberculosis in New York City.—Quarters ending March 31, 1919 and 1920.—

		Manhattan	Bronx	Brooklyn	Queens	Richmond	City
Population	1919	2,780,485	645,894	2,070,539	406,236	103,640	6,006,794
	1920	2,829,239	669,233	2,117,908	419,506	105,559	6,141,445
New cases	1919	2,015	440	1,466	81	62	4,064
	1920	1,982	406	1,074	178	46	3,686
Total cases in register	1919	16,846	3,229	7,151	1,465	271	28,962
	1920	14,064	3,472	6,741	1,565	266	26,108
New patients examined at clinics	1919	2,097	456	1,334	184	29	4,099
	1920	1,696	397	1,017	213	30	3,353
Total visits to clinics	1919	11,026	3,304	6,712	1,431	213	22,686
	1920	8,542	3,312	5,022	1,461	195	18,532
Cases under supervision	1919	120	161	407	2	4	494
	1920	108	173	346	1	5	633
Voluntary renovations	1919	496	77	219	37	34	883
	1920	228	85	129	8	30	480
Sputums examined	1919	7,003	1,502	2,767	489	84	11,845
	1920	5,717	1,701	2,559	509	101	10,584
Positive sputums	1919	1,350	230	663	122	17	2,382
	1920	1,094	208	487	111	15	1,915
Deaths	1919	1,156	264	767	167	53	2,407
	1920	899	231	621	151	37	1,939
Death rate per 1000 of population	1919	1.69	1.66	1.50	1.67	2.08	1.43
	1920	1.27	1.39	1.18	1.44	1.41	1.27
Deaths all forms tuberculosis	1919	1,321	287	842	193	59	2,702
	1920	1,044	262	688	171	41	2,206
Death rate per 1000 of population	1919	1.93	1.80	1.65	1.93	2.31	1.83
	1920	1.48	1.57	1.30	1.64	1.56	1.44

—*Weekly Bull., Dept Health, N. Y. City, July 24, 1920, ix, 236.*

The Sanatoria.—The sanatorium for the care of the tuberculous is generally looked upon as the most effective weapon in the campaign against tuberculosis. The last twenty years have seen a remarkable development of these institutions in the United States, Great Britain and the continent of Europe. There are no less than 600 sanatoria in the United States, and it is estimated that more than 120,000 persons receive treatment therein annually. The annual maintenance costs of these institutions is not much less than thirty millions, and it is estimated that close to sixty millions have been expended in their initial construction.

It is, therefore, pertinent to ask, what is the effect of such institutional care? Is the expenditure of money on their construction and upkeep justified by the results? Is the confidence of the public and of the medical profession in their efficacy well founded? To these questions it is impossible at this time to give a decisive answer. It is surprising, but nevertheless true, that those who have managed sanatoria in our country have, with very few exceptions, proceeded on the theory that the utility of sanatoria was proved and needed no further justification. Patients have been received, cared for and discharged without any provision to keep track of the results accomplished. Patients have been turned out by the thousands without any but the loosest ties to bind them to the sanatoria. As a result, they have, within a few months, or years, drifted away and have become entirely lost to such institutions either for medical supervision or for the determination of the permanent benefit which may have resulted from the treatment received.

There are, to be sure, exceptional places which have attempted to meet this requirement. Trudeau Sanatorium, under the able guidance of Dr. Brown, has for many years maintained such contacts and has published interesting studies of the after-lifetime of its patients. The late Dr. King of Loomis, Dr. Lyman of Wallingford and, more recently, Dr. Bardswell in England, have issued reports showing the expectation of life of those who are discharged from sanatoria and how the longevity of such persons compares with the general run of the population at the corresponding ages. As might be expected, this follow-up work has been done by sanatoria of the finest type. Their patients have been, on the whole, those who would more likely coöperate and give the best results in terms of longevity. Yet, these very results indicate that even in the best cases, where they enter as incipient and are discharged as arrested, the subsequent mortality is from three to four times as great as that of the population at their respective ages.

For the rank and file of institutions, virtually nothing is known. It is common knowledge that many patients are graduated after a few months care, and go back to their former work and habits with little or no supervision. They soon break down either to repeat the cure or to progress rapidly in their disease and die at home or in hospitals for the care of advanced cases. Those who maintain good health are not noticed, and a wrong impression is spread broadcast as to the ultimate value of the treatment. There is a growing scepticism abroad as to the value of the mass of institutions and the question must be taken up and answered.

The follow-up of sanatorium graduates must become an integral part of sanatorium care, just as essential to both patient and institution as any other of the routine procedures of sanatorium treatment.

It is, therefore, recommended that:

1. A central agency or bureau be established to organize post-sanatorium follow-up work on a national scale.
2. This bureau might well be under the auspices of the National Tuberculosis Association.
3. The sanatoria of the country agree to participate in this effort.
4. Uniform records and forms be adopted for use by the coöperating sanatoria in their follow-up work.
5. The central bureau receive the material from the individual sanatoria for the purpose of tabulation and report.

This plan is not at all expensive or difficult to operate. Once put into effect, it will tell us within a short time whether sanatoria are, in fact, accomplishing the results that their supporters hope for. It will indicate which institutions are most effective and will bring into relief the methods which have been found to be most useful in the best sanatoria.—*Tuberculosis and the Sanatoria, Statistical Bulletin Metropolitan Life Insurance Co., July, 1920, i, no. 7.*

Manitoba Sanatorium Book.—This booklet contains in the form of aphorisms valuable information and advice on the following items: the purpose of the sanatorium; the spirit of the place; a plain talk; taking the cure; rest and exercise; more rules; food; constipation; general rules; waste; conduct; matters of business; words to the wise; home-going time.—*The Manitoba Sanatorium Book. Rules and Regulations; Some Advice and a Few Ideals.*

The Tuberculosis Clinic.—The tuberculosis clinic plays a most important part in the health of any community that is fortunate enough to possess one. Many com-

munities and civic bodies are well aware of this fact, as evidenced by the employment of a public health nurse and the establishment of tuberculosis dispensaries. It is generally conceded that the tuberculosis clinic is more uniformly conducted with a paid, than with a volunteer, staff. The author describes the equipment and workings of a tuberculosis clinic. He analyzes the statistics of the Louisville clinic from June, 1918 to May 31, 1919, and gives points on early diagnosis and differential diagnosis.—*The Tuberculosis Clinic, O. O. Miller, Ky. M. J., July, 1920, xviii, 252.*

The Tuberculosis Problem and the General Hospital.—The following questionnaire was sent to many of the largest hospitals in this country: (1) Have you a pulmonary service or ward? (2) If so, is it a special service or a part of the general medical service? (3) What percentage of the total number of beds is devoted to pulmonary tuberculosis? (4) Is this growing, stationary or receding? (5) If you have no pulmonary tuberculosis service, did you have one, and was it abandoned? (6) If so, why? (7) If your institution never had a pulmonary tuberculosis service, does it consider it desirable, or is it contemplating establishing one? The following was sent to most of the large sanatoriums: (1) Should all cases as soon as diagnosed be sent to the sanatorium? (2) Does the sanatorium consider it advisable to have beds set aside in the general hospital for the purpose of study, diagnosis, etc., of cases of pulmonary tuberculosis before sending same to it? (3) Does the sanatorium consider it advisable to have a pulmonary tuberculosis service attached to every general medical service of a large institution? An analysis of the information obtained will reveal: (1) That only about 50 per cent of the large general hospitals (who replied) have a tuberculosis service. (2) In more than half of those that have a tuberculosis service this is a special one. (3) This service wherever existing is stationary and wherever now absent, none contemplate its establishment. (4) Two reply that this service was abandoned because "tuberculosis sanatoria were established in the State." This policy, it must be evident from what has already been stated, is both fallacious and short-sighted. (5) Ninety per cent of the most competent observers in the field of tuberculosis consider it helpful and advisable to have beds set aside in the general hospitals for the purpose of study, diagnosis, etc., of cases of pulmonary tuberculosis before they are sent to the sanatoria for treatment. (6) Over 90 per cent of the best sanatoria in this country consider it advisable and necessary to have a special pulmonary tuberculosis service attached to the general medical service of every large hospital. "For years," writes Dr. C. J. Hatfield, "we have pleaded the desirablility and real necessity for general hospitals to include tuberculosis wards and clinics in their routine plans. I am familiar with the objections, but to my mind they by no means equal the manifest advantages."—A tuberculosis service comprising ward and clinic in the general hospital is not only advisable but absolutely necessary.—*The Tuberculosis Problem and the General Hospital, M. Taschman & B. Stivelman, Am. J. M. Sci., May, 1920, clix, 722.*

A Vocational School for Tuberculosis.—Vocational training of the tuberculous is based upon the observation that properly graduated exercises increase the resistance of the tuberculous patient and counteract the undesirable consequences of an exclusive regimen of rest and food. Such a school has been established in the Chicago Municipal Sanatorium since 1918. The vocations are limited to the ones requiring but little exertion, such as tailoring, dressmaking, dietetics, telegraphy, barbering and beauty culture, and for those who are better prepared, pharmacy, photography and X-ray work. The members of the attending staff decide when a patient is suitable for work. They supervise the training and determine the number of daily work hours, as well as the suitability of the patient for the particular vocation. Seven months is the average stay of the early cases, hence the time is ample for learning a trade. While at the institution the systematic occupation tends to counteract the depression that is so apt to arise under the circumstances. Upon discharge the patient is better prepared to maintain the acquired resistance. Even the advanced cases are trained and are thus spared an existence of utter uselessness. The children receive regular school instruction. The various departments of the institution are utilized as places for training, such as the pharmacy, power house, X-ray laboratory, garden, etc.—*A Vocational School for the Tuberculous, J. D. Robertson, Am. J. Clin. Med., May, 1920, xxvii, 309.*

French Tuberculosis Work.—Before the war tuberculosis had practically no official recognition in France. The problem of a disease which killed almost half of the French people between twenty and forty years of age was largely in the hands of private initiative, propaganda associations and antituberculosis leagues, without concerted effort as regards dispensaries or sanatoriums, and

without obligatory reporting of cases. With the outbreak of the war the dramatic inadequacy of the existing means was soon appreciated and led to the evolvement of a program, which was rapidly carried into effect. It consisted essentially in the establishment of sanitary stations and of committees for assisting tuberculous ex-soldiers. In the sanitary stations the tuberculous soldiers are taken care of and instructed in preventive measures before discharge. The committees comprise departmental subcommittees and the national committee. The latter coördinates all the means in the field of action and renders moral, technical and material support to the local subcommittee, which provides not only for the health needs of the discharged tuberculous soldiers but also for the hygiene and education of their homes. An appropriation through the Ministry of the Interior made it possible to establish special hospitals, so called sanitary hospitals, destined to receive tuberculous soldiers and to separate these from all other patients. At the present time there are 49 such hospitals with a total of 6800 beds. The paucity of prewar means made it necessary to resort to whatever happened to be available. Personnel was developed rapidly by means of courses in the already existing sanatoriums. Equipment and quarters were adapted for the purpose, and thus definite progress was made towards segregation, which was notoriously lacking in most French hospitals. The importance of segregation is evident from the fact that 49,510 patients have thus far passed through the sanitary hospitals, and have thus been prevented from spreading the infection. The selection of the cases is carried on through special centres under the direction of the medical director of the sector. The selection centre acts as the sifting and distributing agency. This diagram illustrates the mechanism of the official tuberculosis agencies:

selection centre → sanitary station → department committee

↓ dispensary ↓ sanatorium ↓ visiting ↓ material assistance ↓ isolation hospital

At present there are 89 dispensaries and 11 sanatoriums. The national committee has the following functions: Coördinating the activities of the departmental committees, associating activities with the Red Cross, etc., allowance of grants, clothing distribution, hygienic utensils, propaganda, etc. These are the results of the organization that has been effected since the war. The increasing interest of the government and the awakening of the public to the problem of tuberculosis guarantee the future of the antituberculosis campaign. Several measures already enacted and others about to be passed by parliament aim at the utilization and extension of the war organization to the conditions of peace. Of course this new path of social medicine can be pursued successfully only with coöperation of the medical profession.—*French Tuberculosis Work After the War, L. Bernard, A. J. Clin. Med., April, 1920, xxvii, 229.*

Antituberculosis Activities in France.—Investigation on the part of the Commission for the Prevention of Tuberculosis showed the need of (1) an intensive campaign of educational propaganda, (2) the maintenance of dispensaries for diagnosis and care of certain cases and such educational work as could be accomplished through these avenues, (3) the maintenance of laboratories for diagnosis and (4) the erection and equipment of preventoria, sanatoria and hospitals. All these activities have been inaugurated and maintained by American organizers, social workers, physicians and workers and by American money. They have made wonderful progress and are now gradually passing from American direction to efficient and permanent French control.—*Antituberculosis Activities in France, C. T. Burnett, Colo. Med., May, 1920, xvii, 132.*

Poultry Farming as an Occupation for Consumptives.—In poultry farming, as in other occupations, the consumptive cannot keep pace with a healthy competitor. Consumptives can work successfully and keep well only in a favorable environment where working hours are regulated according to individual strength, with opportunity to recuperate when a slight relapse occurs, where the diet is ample and properly regulated and where help is at hand, if adverse circumstances are encountered. The Papworth colony has succeeded in establishing a poultry farm built and run entirely by consumptives which has proved financially profitable, the profits being divided among the workers as wages. For those permanently employed on the farm the work is so arranged that relays of workers can be set to do different jobs adjusted to their strength. For those who establish subsidiary farms nearby under the guidance of the colony, extra help is available whenever they may need it. In this way a practical method of employing the consumptive has been evolved; and, by the careful study of other industries on similar lines it will be possible to avoid much of the waste arising from tuberculosis, to economize labor, to promote the welfare of the consumptive, and to add to the protection of

the country.—*Poultry Farming, An Occupation Suitable For Consumptives, P. C. Varrier-Jones, Lancet, April 3, 1920, 793.*

Tuberculosis in Recruits and Pensioners.—In the attempt to exclude all consumptives from active service in the British army some cases, which had no tuberculous disease of the lungs at all, were diagnosed as tuberculosis and placed in sanatoriums. Others were discharged from service with a diagnosis of tuberculosis entitling them to an additional pension, without being tuberculous. In order to avoid this, all chest cases should be dealt with by a board composed of physicians experienced in chest work. Every case should be examined by at least two members of this board and where there is any doubt by all three. When a man has had sanatorium or dispensary treatment for tuberculosis a special report should be asked for from the tuberculosis officer of the district from which the man comes. The special board should pay particular attention not only to the presence of any lesion but to its activity and the amount of disability arising from it. As indicative of activity, rapid or marked loss of weight, a medical certificate of hemoptysis or fever, tubercle bacilli in the sputum, and the presence of persistent localized crepitations, should be considered of greatest importance. Too much stress should not be laid on slight impairment of the percussion note at the right apex, bronchovesicular breathing or apical retraction. The man should be given the benefit of any doubt after exhaustive examination and awarded a high pension assessment. Reëxaminations should be made at intervals not exceeding six months. If the cases become arrested or quiescent, the pension may be reduced 10 or 20 per cent at each examination, so that the reduction in pension corresponds to the permanent improvement in health.—*Diagnosis of Tuberculosis in Recruits and Pensioners, J. Guy, Lancet, March 27, 1920, 711.*

Why Tuberculous Persons without Funds Should Not Leave Their Home States.—Kentucky has at last recognized the principle that the State must give intelligent instruction to those unfortunates infected with tuberculosis, or who are likely to become infected, so that they may be taught how to conduct themselves and earn a living without succumbing to this monster among diseases. With the approval of the Governor, the General Assembly almost unanimously passed House Bill Number 408, which accepts the generous offer of the Louisville Anti-Tuberculosis Association to transfer the Hazelwood Sanatorium to the State, and it will hereafter be known as The Kentucky Tuberculosis Sanatorium. Elsewhere in these columns the Bill will be found in detail. Kentucky's tuberculosis problem is a very large one. There are between 32,000 and 45,000 cases of the disease in the State. Between 4500 and 6000 of our citizens die with it each year. One small state institution will not begin to cope practically with this tremendous problem, but it is the beginning of the recognition by the State of its duty in the matter. The passage of the Bill requiring the training of all school children and teachers in physical education is of even more importance in the prevention of tuberculosis. As soon as educators can realize that their main job is not to teach children so that when grown up they will think, but that when grown up they will know how to live and functionate usefully in society, all of our sanitary problems will be recognized and gradually solved. It is of the utmost importance that tuberculous persons without funds should not leave their home States. The tuberculous poor, who migrate to Colorado, North Carolina or Texas, finding no place where they can be cared for, look for light work in order to maintain themselves and often their dependent families, but such workers are far in excess of the supply. Driven to any work they can get, with neither friends nor care, anxious, homesick, hopeless, they rapidly grow worse and usually soon die. They die for lack of proper rest, food, fresh air and medical attention—those essentials of treatment which many of them could have had at home. No person having tuberculosis should be sent to any other State on account of climatic advantages, unless they have sufficient funds to amply support them for at least two years. —*Editorial, Ky. M. J., July, 1920, xviii, 232.*

After-History of Tuberculous Patients.—The points on which emphasis is laid are: Pulmonary tuberculosis may be cured if treated in its early stages. It is only the early case that derives any permanent benefit from sanatorium treatment (with rare exceptions); hence the futility of clogging the sanatoriums with the more advanced type of case. Much more strenuous preventive measures should be adopted —e. g., additional suitable open air schools and institutions for very advanced cases. There is a sad lack of suitable institutions for the tuberculous child.—*After-History of 500 Consecutive Dispensary Cases, F. G. Collins, Lancet, April 10, 1920, i, 807.*

Mortality in the Glass Industry.—The latest census data give the number of persons employed in the glass industry as 78,804, of

which 74,502 are wage-earners, or about 6,000 more than five years earlier at the time of the census of 1909. The general mortality from pulmonary tuberculosis continues to be excessive among glassworkers as a group, and particularly among glass blowers separately considered, as well as among glass polishers. According to the industrial mortality experience of the Prudential, glassworkers during the period 1914–1918 experienced a proportionate mortality from pulmonary tuberculosis equivalent to 26.3 per cent of the mortality from all causes, which compares with 12.3 per cent for the practically corresponding period of the registration area. This excess, however, shows a diminution from 31.8 per cent for the earlier period of 1897–1914, and particularly so at the important age period twenty-five to thirty-four. Considering the glass blowers only, it appears that the proportionate mortality from pulmonary tuberculosis was 32.1 per cent during the period 1897–1914, and that by 1914–1918 this had diminished to 25.9 per cent. The mortality at the age period twenty-five to thirty-four diminished from 53.3 per cent during the earlier period to 39.7 per cent at the present time, but the excess even at the last-named period is clearly emphasized by the comparative figure for the registration area, which was only 29.5 per cent. It would seem, therefore, a safe conclusion that, while progress has been made in the direction of a diminishing mortality from pulmonary tuberculosis among glassworkers, the reduction has not been proportionately as large as the general progress in the prevention, treatment and control of the disease would seem to justify.

In view of the excessive mortality from pulmonary tuberculosis and possibly from nontuberculous respiratory diseases among certain occupations in the glass industry, it would seem of equal importance that an investigation corresponding to that of granite cutting industry should be made into the glassworkers' trade. There should be no difficulty in securing a similar whole-hearted coöperation on the part of the state authorities, the manufacturers, and the labor unions, the assistance of all being absolutely indispensable if the best possible results are to be obtained. All of the information secured in such an investigation concerning individual establishments or individual employees is considered strictly confidential, since it is only the collective results that are of most value for teaching or remedial purposes. The glassworkers' trade is one of the most indispensable and useful occupations known. The prolongation of the glassworker's life and the prevention of needless disease is, therefore, an important duty of the state and of all voluntary health-promoting agencies which can aid an effort first to ascertain the facts, and then to apply the resulting conclusions for the purpose of bringing about a better state of things. It is sincerely to be hoped that such an investigation will be made so that the facts may be known and, if conditions prove to be better than assumed, a further reduction in extra premium charges for life insurance may accrue to the benefit of wage-earners in the glass industry, and material restrictions may be removed in the case of occupations at the present time considered doubtful.—*The Mortality from Respiratory Diseases in the Glass Industry, F. L. Hoffman, J. Industr. Hyg., May, 1920, ii, 1.*

A New Book on Animal Tuberculosis. —Appearing as one of a collection of 25 volumes upon the subject of tuberculosis, which is being prepared by Chantemesse, Poncet and Collet, of France, is a most comprehensive and complete treatise upon the subject of tuberculosis among animals, prepared by Vollée and Panisset. In the production of this work the authors have made a thorough study of the writings of earlier investigators, and the bibliographic index which is included in their treatise is one of the many valuable features of the book. It is gratifying to note that the names and writings of American investigators are given a prominent place in the discussion of the various phases of animal tuberculosis. Extracts from the conclusions reached by such writers as Theobald Smith, Leonard Pearson, Park and Krumwiede, M. P. Ravenel, V. A. Moore, and several scientists engaged in research for the Bureau of Animal Industry, appear with pleasing frequency throughout the entire work. Questions that have led to heated discussions in years past are treated fairly by the writers and at suitable length, but in no instance are they drawn out in tiresome detail. The chapter on diagnosis is in itself a work of the greatest interest and value. The preparation, application and effectiveness of tuberculin, by the different methods of testing, are described fully and in an interesting and convincing manner. The chapters on immunization and prophylaxis are of great practical value at the present time when such determined efforts are being made by stock owners to establish herds that are tuberculosis-free. No attempt is made to minimize the persistent effort that is necessary to eradicate tuberculosis from an infected herd, but where all modern means of fighting the diseases are faithfully utilized the prospects of finally gaining a healthy herd have not been more promising in many years. Consider-

able emphasis is justly placed upon the value of the education of stock owners. Convincing them of the danger that threatens where tuberculous animals are carelessly purchased and placed with sound stock, or in case tuberculous cattle or hogs are allowed to remain in herds that are otherwise healthy, is a positive step in advance toward reaching the desired goal.—*Les Tuberculoses Animales. By H. Vallée, Director of the Veterinary School at Alfort, and L. Panisset, Professor of the Veterinary School at Lyons. One volume of 528 pages, with 8 colored plates. Octave Doin and Brothers, publishers, Paris, France. Price 14 francs.* (*From J. Am. Vet. M. Ass., July, 1920, lvii, 485.*)

California Agricultural Experiment Station.—*Thermal reaction following intradermal injection of tuberculin.* Investigations of this station have pointed out that the intracutaneous injection of tuberculin in suitable doses gives rise to a thermal reaction similar to the one obtained by the subcutaneous method. The intracutaneous dose used by the California State Veterinarian in official testing, 0.2 cc. of 5 per cent solution of alcoholic precipitated tuberculin, is sufficient to bring forth this result. The practical application of these observations is evident. One can, by one injection, make use of two diagnostic manifestations of tuberculin application, namely, general reaction as indicated by rise in temperature and a local reaction. The San Francisco County Medical Milk Comisssion has recently adopted this method of testing for additions to herds producing certified milk. The subcutaneous test was formerly used.

Combined tuberculin tests. Traum and others have demonstrated that any of the methods of tuberculin testing (subcutaneous, intracutaneous or ophthalmic) will fail to detect an important percentage of tuberculous animals. They have further demonstrated that tuberculous cattle, while giving negative results to one form of tuberculin application, may give positive results to another form. Therefore, the combining of two or more tests has been suggested. The combination which appears most effective is the sensitized ophthalmic with the intracutaneous test, at the same time making a record of the thermal reaction resulting from the latter injection.

Late local reaction to intradermal test. Most frequently positive local reactions can be observed at thirty-six or forty-eight hours after the injection of tuberculin, but a constant, though very small, percentage of cases will not show definite reactions until later. On several occasions during the past five years, there appeared instances where a large percentage of reacting animals failed to show definite reactions at thirty-six or forty-eight hours, but showed such later.

Complement fixation test. Traum and Cooke applied the test to 244 cattle sera; in many cases re-tests were made. Autopsy records were obtained in all. Of 46 cases of severe tuberculosis 43, or 93.5 per cent, gave positive results and 3, or 6.5 per cent, gave no fixation. Of 55 cattle with slight or moderately severe localized lesions, 10 sera, or 18.8 per cent, gave positive results while 45, or 81.81 per cent, gave negative results. One hundred and twenty-nine sera from cattle showing no tuberculous lesions on postmortem showed 12, or 9.3 per cent positives, while 117 were negatives. Seven of the tuberculous and 7 of the nontuberculous sera were anti-complementary and were not included in above figures. The 9.3 per cent of nontuberculous cattle showing positive results argues against the universal adoption of this method, especially in large and in valuable herds. The work on 20 hogs indicated that the complement fixation test is of no value in diagnosing tuberculosis in these animals.

Making cattle environments free from infective tuberculous material.—Environs contaminated with tuberculous discharges from cattle become free from such infective materials soon after the media in which they are contained are freed from sensible moisture. On the other hand, tubercle bacilli that are found in water holes, mud holes and watering troughs retain their virulence for a considerable length of time.

Chemical influence of hypochlorite solutions on tubercle bacilli. In a general way the results indicate (1) that chlorine solutions do not kill tubercle bacilli momentarily in naturally infected discharges; (2) that chlorine solutions are capable of destroying tubercle bacilli under certain conditions; such favorable conditions were not determined by these experiments; (3) that tubercle bacilli were at times not destroyed when subjected to more severe exposure than given in practical disinfection; (4) that in our work the less concentrated solutions proved more effective.

To emphasize the mechanical removal of infection for the good it does and to sanction the use of disinfectants on general principles is a safe and sane stand to take on disinfection in the control of tuberculosis, in the light of our present knowledge.

Tuberculin testing in certified dairies. Two tuberculin tests on all cattle of the certified dairies are made each year, using the subcutaneous and intracutaneous methods alternately. When new purchases are to be made, the entire herds from which they

originate must be tested and not over 10 per cent reactors found. This has been termed the 10 per cent rule and was adopted by the Commission in the hope of further safeguarding the certified herds from the introduction of tuberculosis with new purchases of cattle.

Years of observation with the rise and fall of tuberculosis in certified dairies has always shown rises following the purchase of new cattle. It is very difficult to purchase cattle in California under the 10 per cent rule. The additions to one of the certified dairies, with no reactors, were obtained by going outside the state and eliminating all herds with any reactors so that many more animals were tested than were actually purchased. It, therefore, appears that the best way to keep tuberculosis at a minimum in the certified dairies is to have each owner raise sufficient calves to keep up the supply of milk, thus rendering unnecessary the bringing in of cattle from outside sources.—*Work of the Division of Veterinary Science. Reprinted from the Report of the College of Agriculture and the Agricultural Experiment Station of the University of California, from July 1, 1918, to June 30, 1919.*

Two Interesting Cases.—The cases are reported from the Municipal Sanatorium at Otisville, N. Y. A woman of thirty-two suffering from incipient pulmonary tuberculosis, had been doing well from the time of her admission, in May, 1918, until January 1919, when she contracted influenza. She, developed a right lower lobe pneumonia and a circumscribed empyema. This was drained by a thoracotomy, done under local anesthesia, and the insertion of a rubber catheter. The thick pus evacuated gave a pure culture of staphylococcus aureus. The cavity was irrigated with 1 per cent chlorazene and later with 2 per cent formalin-glycerine. The patient made a complete recovery. A roentgenogram, taken five weeks later, showed obliteration of the cavity and the lung function practically normal.

A woman of fifty-three had been employed in the Sanatorium as seamstress, since 1912. Her family and personal history were negative. Her complaint dated back to 1908, when she had an attack of "stomach trouble." After a few months she again felt fairly well, and remained so until August, 1918. Then she suddenly developed diarrhoea, pain in the abdomen, vomiting and tympanites. The anorexia and pain persisted, but the diarrhoea was periodical. The patient had a constant temperature of from 100° to 102° and a pulse of 110 to 130 per minute. The physical examination revealed marked emaciation, apparent anemia, slight abnormal signs in the apices, indicative of healed tuberculous lesion. The abdomen, except over the ascending colon, revealed marked tympanites. There was no tenderness. The sputum was persistently negative, but tubercle bacilli were found in the feces. She grew persistently worse, and died on January 27, 1919. The necropsy showed the parenchyma of both apices replaced by hard fibrous tissue, the organs of the pelvic cavity covered with fibrinous exudate, subserous tubercles scattered over the jejunum, the mucosa of the jejunum and upper ileum covered with ulcers, from 1 to 4 cm. in diameter, presenting a characteristic tuberculous appearance; in some areas thickened bands of connective tissue the result of old ulcerations; and the mesenteric lymph nodes moderately hyperplastic. The source of intestinal infection was the point of interest. It may have had its origin in the lung and the history of the stomach trouble seven years ago might have been the onset of this. On the other hand the history of sudden onset and rapid course suggests that the tuberculosis was primarily in the intestinal tract. The patient had been working in the institution and consuming food handled by tuberculous patients for the past ten years, and the possibility of this source of infection should be considered. No inoculation or cultivation was done to determine whether the tubercle bacillus was of the human or bovine type.—*Two Interesting Cases from the Records of the Municipal Sanatorium at Otisville, Weekly Bull. Dep. Health, N. Y. City, June 26, 1920, No. 26, 204.*

Trauma and Tuberculosis.—When tuberculosis follows injury, it is more in consonance with pathologic experience to believe that a tuberculous lesion had been present in the body previous to the accident, and had been lying dormant. All that injury, therefore, could do, would be to rouse into activity a lesion which had been inert, probably for years. The subject of trauma and tuberculosis has received additional interest and opportunities of investigation during the war, owing to the large number of gunshot wounds of the chest wall, superficial and penetrating. Oliver's experience is that only in an extremely small number of wounded soldiers has the relationship been observed.—*Trauma and Tuberculosis, J. Oliver, Practit., May, 1920, civ,* 321.

After-Effects of Influenza.—Outstanding features of this report are the high proportion of cardiac cases, covering a wide range of seriousness, the abnormal development of tuberculosis and pretuberculous con-

ditions, and the large number of throat affections. Hardly less striking is the absence of affections of the urinary organs from the statistical record. The total number of persons examined was 7058. Of this number 5624 required medical attention and 1434 were examined but not recommended for treatment, and 2015 were reëxamined. Defective vision, hypertrophy of tonsils and adenoids, diseases of respiratory tract, asthenias, cardiac diseases and defective teeth were the conditions encountered in greatest numbers. The number of tuberculosis cases was striking in the respect that they were, in nearly every instance, new cases, never before reported to the health department. Mason links up with this epidemic the unusually large number of sudden deaths, and presumably from heart disease, in persons who had had influenza.—*Cincinnati Survey of After Effects of Influenza, P. Mason, Modern Med., April, 1920, ii, 305.*

Milk and Tuberculosis.—It appears that the control of human tuberculosis depends to an appreciable extent on a much closer control of bovine tuberculosis. To control this menace, Swift suggests, first, to allow the farmer something nearer the true value for a condemned animal. He would then be a little more willing to help in the fight. Second to start a demand for tuberculosis-free milk. This can be done and ought to be done by education of the physician first, who in his turn will educate his patients. Some farmers have said that they would make tuberculosis-free milk if there was a market for the product and if they could receive a price that would allow them a better margin in which to stand the losses.—*Milk Situation, H. Swift, Boston, M. & S. J., April 29, 1920, clxxxii, 447.*

The Miliary Form of Pulmonary Tuberculosis.—Pissavy explains why and how we must distinguish between the four forms of pulmonary tuberculosis, the miliary, the nodular, the pneumonic, and the bronchitic or emphysematous form.—*Les formes granuliques de la tuberculose pulmonaire, A. Pissavy, Paris Med., January 3, 1920, x, 24.*

Tuberculosis in Children.—The commonest form is tuberculosis of the lymph nodes. It is in the bronchial nodes where the bacilli usually settle and multiply first. Diagnosis: (a) General complaints: malaise, loss of weight, strength and appetite, tendency to colds and sweats, irritability, change in disposition. (b) Fever; the daily range varies from 1.8°F. and over. (c) Anamnesis: tuberculous parents or nurses or attendants, measles, pertussis, influenza, during which the tuberculosis antibodies disappear or become greatly attenuated; unfavorable living conditions. (d) Cough: it may be absent which never speaks against infection of the bronchial nodes. It may be catarrhal. It may be paroxysmal due to pressure on the vagi. Very characteristic is a metallic pitch, due to narrowing of the bronchi from swollen glands. The same cause gives rise to the expiratory wheeze. The latter two varieties occur only until the second year. (e) D'Espine's sign. (f) Percussion of the spine: on slowly percussing from above downward a sudden change to dull is heard in the fifth and sixth dorsal spine area. (g) X-ray examination is the most important and in many cases the only diagnostic method. Every suspected child should be examined several times by physical, biological and roentgenological means. By palpation a search should be made for enlarged lymph nodes in the neck, in the supraclavicular space and on the chest wall. Tuberculosis of the bones and joints is practically never a primary lesion. Traumatism usually favors the migration of bacilli from the bronchial glands into the injured tissues. Cutaneous tuberculides are pathognomonic. They are caused by partial antigens and are a sign of hypersusceptibility. In the lesions of erythema induratum Much's granules have been found; likewise in phlyctenules of the conjunctiva. Tuberculosis of the lungs is usually secondary to disease of the glands. It is certainly the best solution to consider pulmonary and glandular tuberculosis as the first stage of the invasion. Clinically we watch for changes in the breath sounds below the clavicle, near the spine and in the interscapular space. Pleurisy is practically always tuberculous. The biologic test is most important, either Moro's or Pirquet's. Their interpretation varies according to special conditions. Tuberculous meningitis and miliary tuberculosis are fatal. They occur when immunity diminishes or disappears from any cause and during that period bacilli enter the blood stream. Prognosis: as long as relapses are possible a good prognosis cannot be given even when signs and symptoms are absent for the moment. Treatment: aims at improvement of the immunity. For the bronchial lymph nodes specific and X-ray treatment are paramount. Much uses the partial antigens (partigens): for the first three or four weeks, injections 3 times a week; thereafter twice; duration twelve weeks. The greater the dilutions the better. The X-ray treatment is to be done by an expert in 3 or 4 series of two to four weeks. It has to attack the hilum region. Adjuncts in the treatment are proper feeding, the proper amount of

rest and exercise, regular baths with sea salt, administration of calcium. The climatic advantages of a stay at the sea shore or in the mountains are welcome but not necessary. The practitioner can treat most cases of tuberculosis in children. We should never neglect to actively treat tuberculosis of the bronchial lymph nodes.—*Kinder-Tuberkulose, ihre Erkennung und Behandlung, ein Taschenbuch für praktische arzte, Hans Much. Leipzig, Verlag Curt Kabitzsch, 1920.*

Tests for Tuberculosis and Consumption.—The distinction between tuberculosis of the lungs and consumption would in this country probably correspond to that between a tuberculous infection and tuberculous disease. Suppuration and cavity formation form no part of the tuberculous infection, and the tubercle bacillus also does not cause suppuration, at any rate, directly. Consumption is not tuberculosis of the lungs but is due to infection of the damaged lungs by pyogenic organisms. Excavation of the lungs occurs in the repeated absence of tubercle bacillus from the sputum and the postmortem shows excavation of the lungs independent of tuberculosis. Hemoptysis is a feature of nontuberculous excavation of the lungs. Such forms of consumption are caused by catarrhal colds and if these were reduced, consumption would be similarly reduced. When a person develops symptoms showing that he has tuberculosis of the lungs, Shaw would call him a healthy reacting carrier. In the diagnosis of this condition the tuberculin test is of no value. The diagnosis here must be based upon symptoms, signs of functional disturbance. Loss of weight, or rather being underweight, is the most important of all these symptoms. In many cases if a person is underweight and has a cough the diagnosis of tuberculosis of the lungs may be justified. It is wrong, however, to send such patients to a sanatorium and remove them from home and friends; likewise, to report them, unless tubercle bacilli are present. These cases are rare under forty years of age. They do not usually show many physical signs; apical râles usually cannot be detected. Cases of consumption also should not be reported unless there are tubercle bacilli in the sputum, nor need they undergo sanatorium or outdoor treatment.

The object of the tuberculosis campaign is to prevent the healthy reacting carrier, who will always be with us, from becoming (1) a case of active tuberculosis of the lungs and other organs; or (2) a case of consumption.—*The Tests for Tuberculosis of the Lungs and for Consumption, H. B. Shaw, Practit., March, 1920, civ, 167.*

Early Diagnosis. — From pathologic knowledge of the development of tubercle and from clinical and X-ray experience, two types of pulmonary tuberculosis have been differentiated. The "open" (tubercle bacilli usually present in sputum), alveolar or parenchymatous type, in which the disease is present in the lung tissue itself, and the "closed" (tubercle bacilli rarely present in the sputum), peribronchial type associated with definite hilum lesions. Such types are considered to conform in a general way with the open and closed types of tuberculous joint disease. The French school (Rist and Sergent) deny that any recognition of pulmonary tuberculosis can be made before the finding of tubercle bacilli in the sputum. Unfortunately the peribronchial or closed type yields practically no or few physical signs and roentgenologists cannot as a whole be relied upon to make a definite diagnosis of active disease in this type of case. There is no question that comparisons of serial X-ray plates over many months does offer a means of determining what may be termed the "subterranean" spread of tuberculosis. There is one physical sign which, though it is not pathognomonic, is, nevertheless so important that it should always arouse suspicion of phthisis and lead to testing of the sputum; and this is a physical sign not of percussion or auscultation, but of inspection; namely, local wasting of the tissues above and below one clavicle in front or in one supraspinatus region behind. This local wasting is not due to local retraction of the chest wall or to the loss of underlying bone tissue; it is a dwindling of the bulk of the upper part of the pectoralis major and of the subcutaneous tissues, and it is comparable with the wasting that occurs in that part of the limb which is immediately above a joint that is diseased or injured. So in the case of recent and active tuberculous disease of the apex of one lung there seems to be, temporarily at any rate, a neurotrophic reflex which causes local atrophy of the chest wall muscles in the corresponding region. (French, *Guy's Hospital Gazette*, 1918.) In pulmonary tuberculosis we treat symptoms and not signs, and we must cultivate among ourselves and our patients an attitude which will permit of an adjustment of environment before tuberculosis is allowed to become manifest. Especially those who belong to tuberculous families or who have been associated in childhood with tuberculosis "carriers," should be carefully watched. Probably over 30 per cent of cases of pulmonary tuberculosis coming under observation belong to this class. When possible, a yearly examination at least by X-ray and clinical means should be arranged. Repeated and thorough examination of even

minute quantities of sputum is of paramount importance. Theoretically, from the spread of tuberculosis through the lungs, from some definite deposit, probably at the hilum, we should be able to predetermine the candidate for pulmonary disease. In practice, however, we cannot do so any more than we can foretell what individual may succumb to any other bacterial disease. Up to date it is impossible to measure immunity, and to estimate accurately what conditions or environments will eventually lead to active pulmonary tuberculosis.—*The Early Diagnosis of Pulmonary Tuberculosis, G. B. Webb, Editorial, J. Lab. & Clin. Med., June, 1920, v, 626.*

Diminution of Diaphragm Movement.—Air entry into the lung is dependent on diaphragmatic and costal movements: hence any diminution in these movements will give rise on the fluorescent screen to diminution of the difference in illumination between inspiration and expiration, and on percussion to the difference in the notes obtained during these two phases of respiration. Berry claims to have seen this many times. Therefore, he regards the use of the roentgen ray as of value in the early diagnosis of pulmonary tuberculosis because this functional derangement of the diaphragm may be seen before there is any evidence of organic change. The same observation has also been made by others.—*Roentgen Rays in Early Diagnosis of Pulmonary Tuberculosis, M. Berry, Brit. J. Tuberc., January, 1920, xiv, 12.*

The Temperature in Pulmonary Tuberculosis.—The body temperature is the best single indicator of the degree of activity of a tuberculous focus in the lung. Except in cases, which have lost their reactive power due to intense toxemia, absence of fever indicates an equilibrium between the offensive and the defensive forces involved in the pathological process. However, one must bear in mind the frequent tendency of tuberculosis to intermittent quiescence for weeks or months. Because of chronicity of tuberculosis its temperature variations are often slight, hence requiring great care for their detection. Of the four clinical methods of taking the temperature commonly used the axillary, mouth, and urine stream methods are subject to a great number of influences, which readily vitiate the result. The most reliable method is to take the temperature in the rectum, with the bulb inserted 1 to 1½ inches, for at least five minutes. In the great majority of people there is a diurnal variation of the temperature of about 1°F. between the hours of 2 or 3 A.M. and 3 to 8 P.M. In tuberculosis it tends to be greater. The degree of amplitude is a measure of the gravity of the prognosis. The normal temperature taken immediately on rising is 97° to 97.6° by mouth, or 97.4° to 98.0° by rectum. The normal afternoon temperature taken at about 6 P.M. after a thirty minutes rest should not exceed 98.4° by mouth or 99.0° by rectum. Females have a slightly higher level before or during menstruation, the rise however not exceeding 0.6° for both morning and evening readings. Exercise has a considerable effect upon the body temperature. In a healthy person after a one hour walk at 4 miles per hour the rectal temperature rises on the average to 100.7°; after a walk of an hour at six miles per hour the temperature averages 103.2°. These rises recede to normal after resting for a half-hour. In the tuberculous similar amounts of exercise tend to send the temperature higher and the fall on resting is slower. After excluding other infections as the possible cause of the temperature rise after exercise, such a pyrexia may be used as an indicator of the activity of the tuberculous lesion. In general the higher the morning temperature the more severe is the case and the more protracted the convalescence. Failure of the pyrexia to respond to rest makes the prognosis the worse the longer the rest. A common type of temperature curve (mouth) in chronic pulmonary tuberculosis is as follows: On rising 96.8°F. to 97.2°, increasing slowly to 98.4° until about 2 P.M. (associated with chilliness); between 2 P.M. till about 4 or 5 P.M. the maximum of 99.0° to 99.6° is reached (malaise, headache, tachycardia); from now on the patient begins to feel better and by 9 P.M. the reading falls to 97.0°F. or 97.4°, rising somewhat in the morning to 97.4° or 98.0° (pseudo-inversion). An amplitude of 2° with a subnormal morning temperature is characteristic of tuberculosis. Rest diminishes the amplitude by approximating the extremes of the curve. The observation of the morning temperature is quite essential. A morning rise to 98.0° from a lower level, even when unassociated with an afternoon rise should be regarded as pyrexia, and as an index of the amount of exercise to be allotted. Similarly a persistent rise even if only of the afternoon level to 98.6° or over must be regarded as abnormal, and is often associated with other signs of lack of progress. Sporadic aberration of the diurnal variation, while commonly due to trivial causes, may herald an exacerbation of the lesion. The assumption that some patients have a higher normal level than that given above is erroneous, their general progress notwithstanding. Most of these patients were observed to

relapse. Recumbency is the most important factor in temperature reduction. Occasionally a pyrexia not responsive to rest may be favorably influenced by carefully graded exercises. Weather plays an insignificant part in fever. Antipyretics do not affect the temperature beyond a transient effect. If an irregular pyrexia gives way to a regular one, even if the mean remains the same, it is usually a good omen. A jumpy temperature without lung symptoms and signs is often produced by a lesion in other organs. On the other hand nontuberculous toxemias like pyorrhea alveolaris and intestinal toxemia may produce a tuberculous type of curve. As regards the significance of mixed infection in the fever curve, sufficient postmortem material has not as yet been correlated with the changes in the temperature curve. The above deductions have been drawn from observations with regard to prognosis and treatment.—*The Temperature in Pulmonary Tuberculosis, J. Watt, J. State Med., June, 1920, xxviii, 161.*

Hyperpyrexia.—Lesné and Binet report the case of a woman of thirty-eight inclined to be ultra-nervous, who in the course of a meningeal reaction during mild pulmonary tuberculosis had the temperature run up to 43.7°C. (110°F.) and again six days later to 44°C. (111.2°F.), measured in the rectum with three thermometers. It kept at 43.2°C. (109.5°F.) for more than twenty-four hours. The nervous system is undoubtedly responsible for this hyperpyrexia, and treatment should aim to reduce the nervous excitability and induce sleep.—*Hyperpyrexie, E. Lesné & L. Binet, Presse Méd., May 12, 1920, xxviii, 295.*

Errors in Diagnosis of Pulmonary Tuberculosis.—In the 471 necropsies at the Phipps Institute there were six cases which were not tuberculous; of these six two were properly diagnosed (both cardiovascular disease) and four were diagnosed tuberculosis, though one was carcinoma, one actinomycosis and two cardiovascular disease. This represents an error in less than 1 per cent. These statistics constitute Walsh's personal experience with advanced cases diagnosed by about twenty different physicians, and, coming as they do from necropsies on consecutive deaths, represent what a study of the physical signs can accomplish.—*Errors in Diagnosis of Pulmonary Tuberculosis, J. Walsh, Penna. M. J., March, 1920, xxiii, 33.*

Complement Fixation.—The results of 6,128 complement fixation tests made on 1,207 serums from 1000 patients point to the fact that this is not a 100 per cent test for the diagnosis of tuberculosis. A considerable percentage of serums from incipient and far advanced cases apparently contain insufficient antibodies to fix complement, no matter what system or what antigen is used for the test. This fact, therefore, precludes the probabilty of a 100 per cent test based on complement binding antibodies in the patient's serum. About 70 per cent positive results appears to be the average finding, with all types of unselected active tuberculous cases, for many thousands of complement fixation tests made by many serologists, using tubercle bacillus suspensions or tuberculins as antigens. The reactions are weakest when the patient exhibits few, if any, symptoms of tuberculosis, while they are most definite and strongest in the incipient and moderately advanced cases exhibiting marked symptoms. The results are therefore more confirmatory than actually diagnostic in the largest percentage of cases. However, when used intelligently, along with the clinical history, the results justify its more extended use.—*Complement Fixation Test for Tuberculosis, H. O. von Wedel, J. Immunol., March, 1920, v, 189.*

Arneth's Reaction in Pulmonary Tuberculosis.—A series of thirty cases with positive sputum representative of various stages of pulmonary tuberculosis were examined on at least three occasions over a minimum period of two months. The average time each case remained under investigation was 3.8 months. The average blood examinations made were 4.15 per case, a total of 124 blood films being counted. Analysis of these cases showed that 29 had a more or less marked shift to the left, and 10 a definite and continuous shift to the right. There were 10 deaths, 10 cases discharged unimproved after treatment, and 10 cases definitely improved. Although these figures bear out, to some extent, claims made by other observers that the more marked the left shift the worse the prognosis, it also reveals the great danger of drawing any conclusions from single Arneth examinations. Again, two consecutive examinations showing a marked rise in the Arneth count are not necessarily indicative of an improvement in the lung condition of the patient. In view of the fact that the average tuberculous sputum usually contains considerable numbers of well preserved neutrophil leucocytes, films of tuberculous sputums were stained by Unna's polychrome-blue method, and the results contrasted with blood films of the same patients taken the preceding day. The first ten cases examined proved remarkably constant, the maximum variation in the count between the sputum and blood films

being in no case more than 5 per cent. Further investigation showed, however, that the leucocytes of many perfectly fresh tuberculous sputums were disintegrated and impossible to count and the method was abandoned. On the whole, Treadgold's observations showed that a shift to the left is usually present in cases of active pulmonary tuberculosis, the degree of shift being most marked and generally progressive in dying patients. It is less marked and is apt to remain fairly constant in cases which do not improve under treatment, while cases definitely improving usually show the least degree of shift, and this becomes progressively less as improvement continues. A constant and marked left shift in early suspected cases of pulmonary tuberculosis, where other sources of infection can be excluded, is presumptive evidence of active mischief. A left shift under 200 in old cases of "clinical arrest" is suggestive of recurrence and calls for minute and careful reëxamination.—*Significance of Arneth's Reaction; with Particular Reference to Pulmonary Tuberculosis, H. S. Treadgold, Lancet, March 27, 1920, i, 699.*

Sunlight in the Sterilization of Tuberculous Sputum.—Técon placed sterilized sand, gravel and dust on a terrace with southern exposure at Leysin, Switzerland, and dropped upon it sputa from consumptive patients, previously examined for tubercle bacilli. Meteorological data were recorded at short intervals throughout the experimental period. Sputa thus exposed to the mountain sun in the summer for periods of from two to over fifty-two hours—the experiment in the latter case extending over nine days—all gave positive results when subsequently inoculated into guinea pigs; in some instances, however, the onset of tuberculous disease was considerably delayed. All the experiments but one were conducted in cloudless weather. In another series of tests sputum was exposed to the sun on beaten snow. In these tests the sputum was regularly rendered sterile in less than twenty-nine hours. The marked discrepancy between the temperatures by day and night in this series is thought to have been a factor in the sterilization, but there are other possible factors, such as reflection, ultraviolet rays, etc. In one experiment sputa from the same patient, and with approximately equal bacterial content, were exposed simultaneously on snow and on the above mentioned reproduction of an ordinary footway. After twenty-three hours of isolation on the latter medium the sputum gave positive results in guinea pigs, while after like exposure on beaten snow inoculations were negative. This shows that the difference between temperatures by day and night cannot be the sole factor in the more rapid sterilization upon exposure over snow. The general conclusion from the experiments is that the sterilizing value of sunlight on tuberculous sputum discharged upon public highways is practically negligible in the summer time; it is more marked on sputum discharged on mountain roads during the snowy season.—*De la valeur du soleil comme facteur de stérilisation des crachats tuberculeux expectorés sur la voie publique, H. Técon, Paris Méd., January 3, 1920, x, 33.*

Frequency of Spontaneous Pneumothorax in the Course of Artificial Pneumothorax.—Lung perforation by tearing of adhesions is much more frequent than commonly admitted and is often not as grave as most observers believe. It is often responsible for the effusions which occur in about half of the cases of artificial pneumothorax. These pleuropulmonary fistulae usually have a valve-like action. The intrapleural pressure is always positive and usually fairly constant. The primary and secondary manifestations depend on whether the perforation takes place in a sound or in an infiltrated caseous portion of the lung. The signs and symptoms may be nil, or simply a little stitching pain after the nitrogen insufflation, a slight rise of temperature, a little more rigidity of the chest wall, an increased displacement of the heart, and a small effusion under the X-ray. The manometric determination of the intrapleural pressure clinches the diagnosis. A case is reported from Bard's clinic, whose teachings the author reproduces.—*Perforation pleuro-pulmonaire et épanchement pleural consécutif au cours du pneumothorax artificiel, H. Lux, Progr. Méd., May 22, 1920, 231.*

Hyperplastic Tuberculosis of the Intestines.—The serous form of tuberculous peritonitis is not uncommon and is often benefited by laparotomy and the removal of the appendix or Fallopian tube which may be the focus of infection. In plastic or serofibrinous tuberculous peritonitis, however, and in ulcerative enteroperitoneal tuberculosis the prognosis is much less favorable. Factors which constitute indications for surgery in chronic hyperplastic tuberculosis of the intestines and which influence the results are the slow growth of a painless tumor with tendency to stenosis and obstruction, limited area of involvement permitting of excision, the attenuation of the tuberculous infection in the lesion, and the comparative freedom from association with active pulmonary tuberculosis. Six cases are reported. Tuberculosis of the intestine

is encountered in four types. (1) Ulcerative type, which is a common and often primary lesion in children and a secondary lesion in adults with advanced pulmonary tuberculosis. (2) The cicatricial or stenosing type, the result of a completely healed ulcer. It usually occurs in the small intestine and may be multiple, rarely causing obstruction when found in the large intestine. (3) The enteroperitoneal type selects the ileocecal region and combines ulceration with hyperplasia, involving the adjacent peritoneum, mesentery and lymph nodes. (4) Chronic hyperplastic tuberculosis constitutes 85 per cent of all tuberculosis of the intestines in adults. It is essentially a disease of the cecum, but is also found in the terminal ileum, the flexures of the colon, and the rectum. The average age in the author's reported cases is just under thirty years. There is a difference of opinion as to whether it is a primary lesion or secondary to pulmonary tuberculosis. In four of the author's six cases there were definite signs of pulmonary tuberculosis. The characteristic pathology of hyperplastic tuberculosis is that of a massive thickening of the intestinal wall, especially involving the submucosa and subserous layer. The tendency is to stenosis and obstruction and usually the entire circumference of the cecum is involved. The submucosa is the seat of the earliest and greatest hyperplasia, and tubercles and giant cells are most frequently found here. The muscle coats are little affected. The overlying peritoneum is much thickened and the lymph nodes are practically always enlarged. Tuberculous peritonitis or perforation may occur. The onset is slow and the early symptoms are indefinite gastrointestinal disturbances, frequently with alternating constipation and diarrhoea. Fever, weight loss, and so forth, occur late unless due to pulmonary or other complications. Pain occurs with stenosis. In the author's series symptoms were present for only three months. The differential diagnosis includes carcinoma of the cecum, appendicitis, chronic intussusception and diverticulitis or carcinoma of the sigmoid. Ileum alone, 1 case. Ileum and cecum, 1 case. Cecum or ascending colon, 2 cases. Cecum and rectum, 1 case. Sigmoid, 1 case. Radical resection, with appropriate anastomosis, is the operation of choice. Partial exclusion is the simplest and safest procedure as a palliative treatment. An artificial anus in the afferent loop must be considered only as a measure of last resort.—*Hyperplastic Tuberculosis of the Intestines, S. Erdman, Ann. Surg., May, 1920.*

Tuberculous Ulceration in the Vulva.—The extremely chronic course, the fistulous passages, edema and proliferation suggesting elephantiasis, form a characteristic picture of this manifestation of tuberculosis. Schade compares a personal case described with those on record.—*Tuberkulose Ulceration der Vulva, W. Schade, Monatsschr. f. Geburtsh. & Gynäkol., March, 1920, li, 190.*

Menstrual Equivalents in the Tuberculous.—The organism seeks to throw off the excess of endocrine secretions that accompany ovarian functioning and which have to be got rid of, unless fecundation occurs. They usually pass off in the menstrual hemorrhage, but in the tuberculous they are liable to make their influence felt first on the points of lesser resistance, inducing congestion and possibly hemorrhage. There may be fever, congestion of the lungs, with hemoptysis, epistaxis, bleeding from hemorrhoids, diarrhea, excessive secretion in nose or bronchi, or there may be vomiting of bile or transient congestion of the liver, or several of these combined.—*Les équivalents menstruels chez les tuberculeux, C. Sabourin, Paris Méd., January 2, 1920, x, 11.*

Hypertrophic Pulmonary Osteo-Arthropathy Following Lung Abscess.—In the case reported there was an involvement of the left lung, probably the effect of an aspiration infection following tonsillectomy under ether. There was a chronic productive cough. There was a rapid enlargement of the feet and hands during a period of six months. A lung abscess was drained, September, 1918, with a resulting persistent bronchial fistula. Mental depression and insomnia were present. There was a slight loss of weight. There was no evidence of syphilis or tuberculosis. The pathologic condition in the enlarged hands and feet and other regions was best revealed by the roentgenograms, which showed besides the enlargement of the overlying soft parts, a definite striated production of new bone in the periosteum of the shafts of the metacarpals and the first two rows of the phalanges, also along the lower ends of the radius and ulna. The corresponding bones of the lower end of the femur, also the clavicles and some of the ribs were to a degree affected. The joint surfaces appeared unaffected. There was fluid in the knee joints. The fingers were not clubbed. No pituitary or thyroid changes were present. There were no headaches, disturbance of vision nor drowsiness; on the contrary, there was very marked insomnia. There were no changes

in face, lips or skull. There was no evidence of abnormal thirst or hunger, and there were no alterations in the special senses. The chest fistula was closed by a plastic operation in August, 1919, and remained closed, even through and after an attack of influenza and right sided bronchopneumonia in January, 1920. The case is of particular interest in reference to the improvement in the osteoarthropathic condition that followed the elimination of the focus of infection in the lung. It may serve as a plea for early definitive surgical action in similar cases.—*Hypertrophic Pulmonary Osteo-Arthropathy Following Lung Abscess. Further Notes on a Previously Reported Case, E. F. Butler, J. Am. M. Ass., July 24 1920, lxxv, 233.*

Treatment of Tuberculosis.—The author wishes to protest against the prevalent neglect of drug treatment. The anemia of tuberculosis should be combated. By the proper administration of iron we maintain a normal or nearly normal hemoglobin index and thus improve oxidation and elimination. The blood salts should be maintained at the physiological standard. Especially the calcium deficiency must be overcome. The dosage of calcium chloride that has been found necessary to accomplish this is a beginning dose of 1 grain, gradually increased until a maximum dose of 6 grains is given. At this point, the dose is slowly decreased as the coagulation time shortens and that amount is then given that will maintain the coagulation time at normal or slightly below normal. The injections, at first, are commonly given every five days, while, as the coagulation time is reduced, more time is allowed between the injections. In patients who have a marked mixed infection, the injections are often spaced ten days apart, and, on the fifth day intervening between the intravenous injections, hypodermic injection of mixed-catarrhal-combined vaccines are given. At each interval when vaccine is given, we also give a separate injection of 1 mil of nulcein. This method has been very successful in combating the associated mixed infections. After an experience extending over six years and covering the treatment of about 250 cases the author came to the conclusion that the results of the intravenous use of calcium solutions have, in a majority of the curable cases, been surprisingly good, while in many instances patients, who had failed to improve under other methods of treatment, have made excellent improvement and uneventful recovery when placed on calcium injections. Attention should be paid to the digestive organs. Excessive cough should be controlled by gargling and spraying frequently with phenol solution one dram to a pint of water). The patients should be encouraged to develop an interest in some useful and entertaining pastime.—*The Therapy of Tuberculosis, T. J. Beasley, Am. J. Clin. Med., July, 1920, xxvii, 449.*

Some Aspects of Desert Climates.—How the body adjusts itself to unusual changes in its environment has always been a problem of interest to those who have to deal with the living organism. The problems of adaptation to altitude, for example, have become of more than mere academic interest since the development of aerial flight by man. Likewise, the mechanism for adjustment to extremes of temperature has aroused attention in greater degree as man has begun to penetrate the Arctic regions and the tropics in consequence of the improved facilities for transportation to almost every region of the earth.

Among the scientific observations made during a recent expedition to the Egyptian deserts[1] are indications that under the peculiarities of climate there encountered a slight though unmistakable increase in red blood corpuscles may occur. This is analogous to the well known increase that is exhibited by man transported to considerable altitudes, where the reduced partial pressure of oxygen evidently becomes a stimulus for the mobilization of an added number of oxygen-carrying corpuscles in the circulating medium of the body. As deficiency in oxygen cannot be held responsible for an increment in erythrocytes and hemoglobin in the blood at the low altitude of the Egyptian desert, some other explanation must be sought for the phenomenon recorded. Special studies have demonstrated that it cannot be explained by any notable concentration of the blood in the tropical climate. The most tenable hypothesis thus far advanced charges a stimulation of the blood-forming organs to peculiar and intensive light conditions that prevail in the desert. Thus it has also been shown experimentally that exposure to the light of the mercury arc may produce increases in erythrocytes in animals. If this assumption proves to be correct, a new aspect of climatology will have been emphasized in the hematopoietic influence of sunlight. It might be assumed that the severe heat of the desert would lead to extreme production

[1] Loewy, A.: Verhandl. d. physiol. Gesellsch. zu Berlin, Sitzung vom 12. Mai 1916, conf. Berl. klin. Wchnschr. 1916, Ztschr. f. Balneol., Klimatol. u. Kurort-Hyg. 9: 43, 1916. Bickel, A.: Berl. klin. Wchnschr., 1916, No. 26. Wohlgemuth, J.: Ueber die Zusammensetzung des Blutes und über das Verhalten des Blutdruckes in Wüstenklima, Biochem. Ztschr. 79: 290 (Feb.) 1917.

of sweat and correspondingly a considerable output of chlorides through the skin. This would be in harmony with the belief that in tropical climates increased output of water is synonymous with increased secretion of sweat. Wohlgemuth's studies at Assuan showed, however, that this view is not tenable. The increased water elimination under the climatic conditions of the desert occurs essentially through the medium of so called insensible perspiration. Accordingly, the chloride content of the blood is unaltered even when the loss of water from the body is considerable under the trying conditions of life in the desert.—*Editorial, J. Am. M. Ass., July 3, 1920, lxxv, 38.*

Artificial Bilateral Pneumothorax.—Abbott tabulates 16 cases of bilateral pneumothorax especially with regards to temperature, pulse, respiration, cyanosis and expectoration. Although the ultimate worth has not been proved, the procedure is safe and has been attended by relief and benefit. Indications: (1) extensive bilateral progressive ulcerative lesions; (2) an awakening of an arrested process on the better side due to overcompensation following a unilateral compression; (3) all active bilateral lesions; (4) symptom-complex of toxemia of bilateral origin. Rules: (1) Bilateral compression should not be done at the first sitting, but only after each side has been treated singly at least twice and followed not only by a period of about two days' rest, but also by a cessation of all distress incident to the procedure. (2) In the initial bilateral compression we seldom exceed twenty-five per cent of the gas used on the opposite side. As the patient becomes accustomed to the process we give to the point of tolerance which we ascertain by asking him to tell us the moment he feels "tight" or short of breath, and we then stop immediately. Occasionally one, unmindful of our purpose, will attempt to "stick it out." To avoid this, we watch respirations closely and on the first evidence of undue shallow or rapid breathing, we withdraw the needle. (3) Never introduce under any circumstances enough gas to cause dyspnoea.—*Artificial Bilateral Pneumothorax, W. R. Abbott, Ill. M. J., March, 1920, xxxvii, 192.*

Tuberculin Treatment.—Several hundred patients have been treated with T. B. E. of Wright and according to Wright's technic. The patient was usually put to bed in the open air until the pyrexia—when present—had subsided. Tuberculin was then given as indicated, the dose being carefully graduated each week, having regard to the nature of the case. The injection was given subcutaneously, and absolute rest for twenty-four hours after was strictly enjoined in each case. Each week the dose was increased by $\frac{1}{10000}$ mgm. or more, according to the patient's progress, until $\frac{1}{2500}$ mgm. was reached. No ill effects were observed from the treatment of serious cases with tuberculin. In fact, Macrae found that in very early cases of pulmonary tuberculosis patients seemed to be benefited by injections of tuberculin. On the other hand, however, other patients did equally well without it; and if it be true that 95 per cent of the human race has, at some time or other, been tuberculous, it must be equally true that most persons have recovered without any kind of treatment. In surgical tuberculosis the case was different. In all glandular affections it was found that incision, followed by tuberculin treatment, was of value.—*Tuberculin Treatment of Tuberculosis, D. M. Macrae, South Afric. Med. Rec., April 10, 1920, xviii, 217.*

An Attenuated Tubercle Vaccine.—Raw, after treating over 3000 cases of tuberculosis in hospitals with tuberculins from various sources, has come to the conclusion that the best results are obtained by treating human infections with bovine tuberculin and bovine infections with human tuberculin, since these two types of bacilli seem to be antagonistic to each other. He states that a pure culture of human pulmonary tuberculosis given him by Koch, in 1905, one of bovine tuberculosis given him by Calmette, and one of avian tuberculosis given him by Bang of Copenhagen in 1905, have been subcultured every month since 1905 without any intermission, and to-day they grow true to type, quite normally, though not so luxuriantly. Tuberculin prepared with these attenuated strains has given very satisfactory results and leads the writer to suggest that tuberculin should be prepared from attenuated and nonvirulent cultures of bacilli; that it should be freshly prepared and used within a week; that it should be given in graduated and increasing doses at intervals of seven days; that acute reactions are unnecessary; that not less than twelve injections should be given at intervals of one week, though many more may often be required. The most favorable cases for treatment are local lesions, though early cases of pulmonary tuberculosis may be prevented from spreading to other parts of the lungs.—*An Attenuated Tubercle Vaccine, N. Raw, Brit. M. J., April 17, 1920, 538.*

Vaccination Against Tuberculosis.—Shiga emphasizes that the only positive prophylaxis against tuberculosis is to attack

it before it has induced manifest symptoms. In the last four years he has treated 300 tuberculous patients with his T B serovaccine, including twenty who received it as a prophylactic vaccination. He uses dilutions of 1:5000 for five weekly injections, 1:1000 for four injections, 1:500 for three, 1:100 for three and then living avirulent tubercle bacilli 1:20 for two injections. The temperature is taken for a week before commencing the course, and if there is fever, the vaccination is begun still more cautiously.—*Vaccine Treatment and Prophylaxis of Tuberculosis, K. Shiga, Kitasato Arch. of Exper. Med., December, 1919, iii, 239.*

Intraspinal Injections of Antimeningococcic Serum in Tuberculous Meningitis.—Thirty-eight cases of undoubted tuberculous meningitis and fifteen doubtful cases, which recovered, are reported in the literature. Except for these cases, treatment as shown by hospital statistics has been 100 per cent ineffectual. The authors report two cases of positive, and two of doubtful tuberculous meningitis which were treated by intraspinal injections of antimeningococcic serum, combined with frequent spinal drainage, and which recovered. One of the recovered cases reported in the literature had been treated also with antimeningococcic serum. Against these must be balanced three cases in which the serum was used at St. Luke's Hospital (New York) with ultimate death. This would total eight cases treated with the serum with five recoveries. This is not urged as a specific treatment for tuberculous meningitis, but as one with which the patient has a chance. The action of the antimeningococcic serum appears to be twofold: first, by adding to the spinal fluid certain antibodies which it is unable to develop itself; and second, by the introduction within the dura of a foreign protein in the form of horse serum.—*Recovery from Tuberculous Meningitis after Treatment with Intraspinal Injections of Antimeningococcic Serum, A. W. Hollis and I. H. Pardee, Arch. Int. Med., July 15, 1920, xxvi, 49.*

Psychotherapy in Tuberculosis.—Psychotherapy is conceived by the author as being treatment by suggestion. By this procedure morbid processes of thought and feeling are replaced by systems of ideas which generate a pleasant emotional tone. The latter exerting a beneficial influence upon the vegetative nervous system furthers metabolism, and thus contributes largely to the favorable course not only of functional but also of organic diseases. Consciously or unconsciously every successful physician is to a considerable degree a successful psychotherapeutist. The long drawn out course of tuberculosis is a particularly suitable field for the suggestions of hope and cheer. These must be brought into play at the very time the diagnosis is made, irrespective of the degree of severity of the affection. Thereafter the physician should impart optimism to the patient at every opportunity. A thoughtful attitude, a painstaking examination, confidence and faith in the method of treatment to be instituted have a powerful mental effect. Whatever good there might be in the climatic change it is chiefly due to its psychological influence. Being rather costly it is often not attainable. To advise a change of climate under such conditions brings on depression and a feeling of hopelessness. There are only two places for a tuberculous patient: the home or a sanatorium. There being no specific remedy for tuberculosis, psychotherapy represents a valuable addition to fresh air, food, rest, tuberculin and other adjuvants. While there may be differences of opinion as to what is desirable in the tuberculosis regimen, there can be none on the beneficial effect of a pleasant emotional tone.—*Psychotherapy in the Treatment of Tuberculosis, W. O. Wilkes, Tex. State J. Med., January, 1920, xvi, 331.*

Therapeutic Use of Oxygen.—Oxygen is very essential to the living tissues. "A man may go for weeks without food, for days without water, but for seconds without oxygen." Anoxemia is the term applied by Haldane to the condition when the rate of supply of oxygen is insufficient for the normal carrying on of life. The causes of it are (1) defective saturation of the arterial blood with oxygen; (2) slowing of the circulation; (3) defective proportion of available hemoglobin in the blood; and (4) an alteration of the dissociation curve of the oxyhemoglobin, so that this gives off its oxygen less easily than usual. Oxygen should be employed in all serious cases of anoxemia and its administration should not be delayed and only used as a last resort; but it should be employed early, before the vital tissues have been much damaged by the want of oxygen. This is universally recognized in cases of mountain sickness and sickness from high flying, and in poisoning by CO, nitrites and arseniuretted hydrogen and also in the effects of noxious gas. For the same reasons oxygen should be tried in all cases of cyanosis and also in acute respiratory conditions, such as pneumonia, when anoxemia threatens. The ordinary method of giving oxygen by holding a funnel connected with the oxy-

gen cylinder near the face of the patient is practically useless. A better method than this is to give the gas through a rubber tube inserted into one nostril, and this may be made more effectual if the opposite nostril be rhythmically compressed during inspiration, the mouth of course, being kept closed. The oxygen chamber is a very effectual way of giving oxygen, especially in chronic cases, but it involves much expense and care. An extremely useful appliance for the administration of oxygen is Meltzer's apparatus for oral insufflation.—*The Therapeutic Use of Oxygen, R. D. Rudolf, Am. J. M. Sci., July, 1920, clx, 10.*

Danger of Heliotherapy in Laryngeal Tuberculosis.—Although heliotherapy and phototherapy are very valuable measures in the treatment of tuberculous laryngitis they are capable, if used unguardedly, of producing tuberculin reactions of indefinite severity and duration and therefore should not be used excepting under the guidance and control of a competent clinician. Four illustrative cases are reported from the Mount Saint Rose Sanatorium.—*The Danger of the Unguarded Use of Heliotherapy in Laryngeal Tuberculosis, N. Barlow, J. Miss. State M. Ass., January, 1920, xvii, 18.*

The Treatment of Dysphagia in Tuberculous Laryngitides.—Dysphagia is one of the most common symptoms of tuberculosis of the larynx, at least at the terminal phase of the process, and is one of the difficulties encountered in the care of those unfortunate patients who are unable to eat, and contributes toward making tuberculosis of the larynx one of the most distressing affections with which we have to deal. Its cause resides in the edema, or rather the infiltration of the upper structures of the larynx—epiglottis, arytenoids, and aryteno-epiglottic folds, with or without ulceration. The sensory nerve, whose territory corresponds with the laryngeal vestibulum, is exclusively the superior laryngeal which, before penetrating into the cavity of the larynx, passes very superficially between the lower border of the hyoid bone and the upper border of the thyroid cartilage. If the examiner pushes the left side of the larynx with a finger of the right hand, the thumb of the same hand will distinctly feel the large horn of the hyoid, the horn of the thyroid and the free thyrohyoid space. A little stronger pressure over this area, especially on the diseased larynx, will at once give rise to rather sharp pain, shooting to the external auditory canal, on account of the superior laryngeal nerve being directly under the examiner's finger. The dysphagia can be controlled in most cases by regional anesthesia and the best procedure consists in pricking the nerve at the point where it underlies the skin, and injecting a few drops of eighty-five per cent alcohol along the nerve. There is a sharp pain at first, extending to the ear, which proves that the injection has reached the proper structures. The pain lasts for but a few seconds and is followed by a complete analgesia and the entire disappearance of the dysphagia. The effect on both the mental state and the physical condition of the patient is naturally considerable. It is curious to note that the edema and infiltration diminish and the mucosa assumes its normal volume. On the other hand, the laryngeal lesions can be directly treated and the patient properly fed. This anesthesia may last for several months following a single injection, in other subjects the amelioration is for only a few days, but it often happens that after six or seven injections a permanent anesthesia ensues. This treatment is practically devoid of danger, if the operator exercises a little care, and does not require any special technical knowledge other than the requisite amount of knowledge of regional anatomy which every practitioner should possess.—*Editorial Note, N. York M. J., July 17, 1920, cxi, 101.*

Intrapleural Hypertension for Evacuating Pus Through Bronchi. — This method of treatment was employed at the Bedford Hills Sanatorium, N. Y., in a case of spontaneous pyopneumothorax with persistent bronchial communication. When the air was introduced for the first time the initial pressure was from 0 to +2 cm. of water. The final pressure was 20 mm. of mercury. The patient expectorated about 60 cc. of pus and the pressure fell to about 1 mm. of mercury. At the fourth injection, 1 cc. of a saturated alcoholic solution of methylene blue was also injected. Immediately thereafter, 150 cc. of air were injected, and during the procedure about 150 cc. of blue sputum were coughed up. The fever chart showed an average reduction of 2° for three days following this purely diagnostic methylene blue injection. At the fifth attempt 50 cc. of 1:10,000 watery iodin solution were injected into the pleural cavity. The patient brought up about 150 cc. of pus during the operation. The iodin solution did not cause any unusual irritation. At the sixth attempt, no hypertension was obtainable even for a short period, for there was evidently insufficient pus in the pleural cavity to cover the pulmonary opening. Comment is made on the possibilities of this pneumatic expulsion of pus, combined if necessary with the filling of the cavity with

sterile saline solution. The hope is expressed that a way may be found to close the pulmonary fistula.—*Intrapleural Hypertension for Evacuating Pus Through Bronchi in Spontaneous Pyopneumothorax, A. Meyer & B. Stivelman, J. Am. M. Ass., July 24, 1920, lxxv, 218.*

End Results of Operation for Tuberculous Peritonitis. – The present view is that operation for tuberculous peritonitis should comprise (1) evacuation of fluid, (2) observation of the extent of peritoneal involvement, (3) removal of the appendix or the uterine appendages if involved to such an extent as to indicate that they were primary foci, and (4) closure of the abdominal wound without drainage. Two cases are reported who are well eleven or twelve years after operation respectively. In the first patient, a girl of nine, the involved appendix had been removed at operation. In the second patient, a girl of fifteen, the involved adnexa had not been removed, but the matted intestines had been disentangled. It is well to treat each case on its own merits and to modify the procedure in whatever manner seems indicated by the general principles of surgery. In such cases of tuberculous peritonitis operation is merely the initiation of treatment. It places the patient in such a condition as to render the dietetic, hygienic and tonic medicinal measures applied to other types of tuberculosis more certain and complete in their effects.—*End Results of Operation for Tuberculous Peritonitis, C. H. Goodrich, Long Island M. J., June, 1920, xiv, 251.*

Treatment of Diabetes Complicated by Pulmonary Tuberculosis.—Summary: Untreated diabetic is more likely to develop pulmonary tuberculosis than the diabetic who is kept sugar-free by modern methods. In a series of sixteen diabetic cases complicated by pulmonary tuberculosis showing activity, twelve patients definitely improved during a course of institutional treatment; diabetic symptoms disappeared in all but two cases, observed but a short interval. Tuberculous symptoms improved in the majority of cases. Principles of treatment recommended are the judicious employment of sufficient undernutrition, combined with rest, to maintain the patient sugar-free and control the tuberculosis. Fasting is unnecessary to obtain good results. Ill advised fasting may lead to a fatal outcome. Rest is at least as important as in the treatment of uncomplicated pulmonary tuberculosis.—*Treatment of Diabetes Complicated by Pulmonary Tuberculosis, N. W. Janney & R. R. Newell, J. Am. M. Ass., July 17, 1920, lxxv, 153.*

Treatment of Tuberculosis in Experimental Animals. A series of guinea pigs were treated with the mycoleum described in the *New York Medical Journal* of January 31, 1920. The first essential in a work of this kind is to standardize the cultures of tubercle bacilli as to virulence. It is difficult to do this exactly, and therefore it is advisable to give such cultures and such doses that most of the guinea pigs die in ninety days or slightly before, and to kill the treated animals as the controls die or vice versa, marking them off in counts according to the scaling table. The system of scaling is essentially the same as that adopted by other workers with only slight modifications. On this basis, in a ninety days series, the counts should average one to three in favor of the treated animals. In one of the series, the guinea pigs lived approximately sixty days and the counts averaged one to two. The number of days lived by the treated over the untreated makes the showing somewhat better. In another batch living approximately eighty days, the counts averaged 1 to 2.6. The experiments as a whole showed that the unchanged, untreated or unbleached mycoleum acts with remarkable accuracy on experimental animals.—*Treatment of Tuberculosis on Experimental Animals, B. S. Paschall, N. York M. J., February 28, and March 6, 1920, cxi, 363 and 423.*

Influence of the Roentgen Ray on Experimental Tuberculosis. — Conclusions: 1. Effect of the roentgen ray on the life of the guinea pig: The author has been unable to hasten the progress of the tuberculosis appreciably by exposure of the guinea pig to massive doses of the roentgen ray. 2. Effect on the leucocytes: The leucocytes of the blood stream are markedly reduced in number by exposure to the roentgen ray. The reduction is proportionate to the length of exposure with a given current and voltage. The lymphocytes are most markedly affected. 3. Origin of the tubercle cells: The cells of the tubercle are probably derived both from the local tissue and from the blood. The presence of the usual number of epithelioid and mononuclear cells in the tuberculous lesions of roentgenized guinea pigs, where there is a marked diminution in lymphocytes, indicates that these cells are not of lymphocytic origin. The presence of an excess of lymphocytes in and around the blood vessels near the tubercles in nonroentgenized animals indicates that cells are carried to the lesions by the blood stream.—*The Influence of the Exposure to the Roentgen Ray on the Progress of Tuberculosis, J. A. Weinberg, Arch. Int. Med., May, 1920, xxv, 565.*

Effect of Ether on Experimental Tuberculosis.—Conclusions: After reviewing the work of Savage, Corper, Brown and Petroff and taking it in conjunction with his own experiments, the author feels that the following conclusions are justified: 1. Ether anesthesia in tuberculously infected guinea pigs fails to exert any inhibitory action on the progress of the tubercle formation or to prolong the life of the animal. 2. Ether anesthesia does not reduce the resistance of tuberculously infected guinea pigs. 3. The danger of harming positive sputum cases of pulmonary tuberculosis by causing aspiration of the infected material into noninfected areas, as well as the direct irritating effect of the ether on the inflamed pulmonary tissue, must not be overlooked.—*Studies on the Effect of Ether in Experimental Tubercle Bacillus Infections, J. B. Rogers, Ohio State M. J., July, 1920, xvi, 509.*

The Prevalence of Tuberculosis in Foreign Countries.—In many foreign countries, and particularly among the natives of comparatively uncivilized communities where health departments are not adequately organized for checking the spread of disease, the extent to which tuberculosis sometimes affects the inhabitants often reaches the proportions of a scourge. A European periodical, "Tubercle," gives an interesting survey of this disease in various countries of the world, including the Malay Peninsula, Egypt, Spain, Austria, Scandinavia, and England. There are still countries in which tuberculosis encounters little resistance, for it is often difficult to help the people because of their fundamental fatalism. The spirit of modern medical enlightenment is beginning, however, to penetrate even the most benighted of regions, and countries which a few years ago were helpless in the event of an outbreak of tuberculosis now are becoming awakened to the dangers of the disease and are showing extraordinary zeal in building up defensive organizations against its spread.

The Malay Peninsula presents an interesting situation. There tuberculosis has broken out on practically virgin soil and has become a plague. The mortality rate for Singapore in 1916 was 48.4 per ten thousand of inhabitants, the rate being nearly twice as great among males of the Chinese population as among females. In our own country, infected milk is considered one of the important sources of tuberculosis; in the Federated Malay States, however, some other cause must be sought, as bovine tuberculosis does not exist there. Furthermore, of more than two hundred and fifty thousand hogs slaughtered at the Ipoh abattoirs, not one case of tuberculosis was found. It seems evident, therefore, that the disease is not caused by infected meat, nor by milk, for the reasons that the cows are free from the disease and both children and adults seldom use milk.

In Egypt tuberculosis has become distributed, seldom affecting the lungs, but almost entirely the glands, bones, and joints. It is difficult to undertake any measures of consequence among the natives toward training them to help themselves, inasmuch as patients are imbued with the idea that the disease is a visitation from heaven to be borne with fortitude and patience. Consequently the condition of the patient is seldom really known until the disease is well advanced and treatment is of little value.

In Spain there has been awakened a considerable interest in the subject of tuberculosis. In Austria the mortality rate from tuberculosis increased during 1917. The figure in 1913 was 3 per thousand of population; in 1917 it had risen to 4.1 and by 1918 to 4.2. The ratio in 1913 was three women to four men, while in 1918 these rates were practically reversed. Among young women the increase was about 113 per cent, among children, 186 per cent. Statistics show further increase in the general rate during the first half of 1919.

About a decade ago, there was initiated in Finland a campaign against tuberculosis which included an entire parish. The people were examined and given instructions in regard to methods of combating the disease; laboratory work was undertaken and efforts were made to trace the sources of infection. A second complete examination was made of the whole population last year and the figures offer interesting comparisons. In 1909 there were 28 per cent of the families with tuberculosis; in 1919 the corresponding figure was 14.6. In 1909 the incidence among the 3200 persons in the parish was 6.2 per cent, now fallen to 2.8 per cent; among young people in the age group eleven years to twenty, the decrease was from 8.9 per cent to 2.6 per cent. The experiment showed the advantage of combating tuberculosis in the younger age groups. During recent years in the Scandinavian peninsula attention has been given to the sociological aspect of tuberculosis. Efforts to secure coöperation in research were interrupted by the war, but they have been resumed. In that country the sun is considered as a therapeutic factor of importance, and its substitutes, the electrical arc light and the quartz-mercury light, are used to a considerable extent.

A review of the situation in England shows that before the war tuberculosis adminis-

tration had been developing and was becoming of great value in the matter of public health. As notification of tuberculosis did not become compulsory until 1913, it was still in its initial stages at the outbreak of the war; but communities were aroused to the importance of the subject and plans were being made on a large scale for the treatment and control of the disease. With the opening of the war the tuberculosis mortality rate in England began to turn from a steadily descending curve to a rising one. The figures for women were approximately seven per cent higher in 1916 than in 1913, and in 1917, 13 per cent higher, due in part, of course, to the extension of industrial instead of domestic pursuits. Examination of the total male population for military purposes revealed for the first time the real conditions, and furnished an important and reliable basis for future public health work. What has been discovered under the stress of war conditions should lead nations in all parts of the world to a realization of the need of complete tuberculosis surveys and the establishment of competent organizations to deal with this important health problem.—*Editorial, Boston M. and S. J., July 22, 1920, clxxxiii, 114.*

Tuberculosis and Race Stock.—The most striking fact in the statistics of tuberculosis in the United States is the difference between the mortality rates of white and colored persons. Whether we study the records of the Registration Area, or the statistics of mortality among industrial policyholders of the Metropolitan Life Insurance Company, the fact is much the same. The death rate from pulmonary tuberculosis among colored people in the United States is between two and one-half and three times that of white persons at all ages. When a more refined analysis is made, it is found that at certain age periods, such as childhood and early adolescence, the mortality among colored persons from this disease is between nine and ten times that of the white. With advancing age, the differences between the two races become less marked. In many communities of the United States, the tuberculosis situation is acute because of the large number of tuberculous negroes. Little has been done to control this condition among colored people who, because of the excessive prevalence of the disease among them, are a constant menace not only to other members of their race, but to the whites as well. These facts have been known for many years, but only recently have we learned to appreciate the significance of the race factor with reference to tuberculosis among the various white stocks of foreign origin in the United States. Mortality studies for Pennsylvania and New York recently published show that very different conditions prevail among those born in various countries but living in these two States. The lowest rates in general appear to occur among persons born in the United States. Those born in Russia, who, in these States are, for the most part, Jews, enjoy very low rates. The Italians and those who were born in the former Austro-Hungarian Empire also show comparatively low tuberculosis death rates. At some of the age periods, the rates among these foreign-born persons were even lower than for the native-born. On the other hand, very unfavorable rates prevail among those born in Ireland, and residing in New York or Pennsylvania. Irish born males and females suffer extraordinarily from this disease during the greater part of life. At ages twenty-five to forty-four years, the rate for Irish males is almost twice as high as for the native, and in the age period forty-five to sixty-four years, the excess is even greater. The figures for this race were higher than those prevailing in their native country for the corresponding age periods. German and British-born males also show much higher tuberculosis rates than were found to prevail among persons born in the United States. In their attack on this disease, health officers should keep the race factor in mind, especially where there is a large foreign population. Special measures of control should be applied where high death rates are known to prevail among the several race-stocks in a given locality. Not so much effort need be expended, perhaps, among such people as the Jews and Italians where conditions are, on the whole, favorable although even among them considerable life saving could be accomplished through public health work—*Tuberculosis and Race Stock, Statist. Bull., Metrop. Life Ins. Co., May, 1920, i, No. 5, 4.*

Protection of Mankind against Tuberculosis.—Tuberculosis is a disease of crowded social communities, its prevalence and gravity increasing with the density of the population. In the same way susceptible animals, such as cattle, are free from the disease in the wild state, whereas the domesticated species, obliged to live in contact with man, are affected in proportion to the closeness of that contact. Overcrowding of houses and the keeping of animals in stables facilitate the contagion. In towns and in overcrowded stables, in the presence of animals or men who are ill or who, even if apparently healthy, are sowers, as it were, of bacilli, this contagion is almost inevitable. Massive bacillary infection in a subject hitherto free—a young child, for instance—

or in adults belonging to countries free from tuberculosis (natives of Central Africa), produces severe manifestations which, developing rapidly, are almost always fatal and of various types according to the number of the infecting bacilli, their origin, and the organs attacked (miliary tuberculosis, typhoid-like infections, gangliopulmonary tuberculosis, caseous pneumonias and meningitis). Massive infection or frequent and copious reinfections, supervening on a preexisting occult bacillary infection or a latent lesion, give rise to resistant types of the disease, namely, pulmonary tuberculosis, chronic phthisis, pleurisy, renal tuberculosis and tuberculosis of the intestinal tract, bones, joints, etc. The gravity of these types is in close relation to the age of the original infection and to the number and source (and hence the virulence) of the reinfecting bacilli, and also to the seat of the lesions and the anatomical relations of the organs affected. Experiments on susceptible animals and clinical observations on human beings have justified the assertion that a mild infection, occurring in early childhood and remaining occult or latent for several years, endows the body with a pronounced resistance to subsequent inoculations or reinfections. Any individual with an occult bacillary infection or with a benign and latent glandular tuberculous lesion will retain for years this special immunity. This may be conferred artificially on susceptible animals at an early age by the careful introduction into their lymphatic organs of small quantities of bacilli, the virulence of which has been diminished or modified so that they are no longer capable of producing tubercles. It remains to be determined what will be the most effective and at the same time harmless procedure for immunizing infants and how long this protection will last. The necessary experiments, first, on young susceptible animals and subsequently on young children, will have to be carried out in an environment hitherto absolutely free from tuberculous infection. For this kind of research a special laboratory could be established in one of the islands of the Archipelago of Los in French Guinea where it would be easy to experiment first on anthropoid apes. The annual income of a capital of about ten million francs would no doubt be sufficient. Meanwhile the scientific facts already established must serve as a basis for concerted action in antituberculous prophylaxis. Our guiding principle in the social campaign against tuberculosis is the protection of healthy subjects, whether infant or adult, against massive or frequent infections.—*The Protection of Mankind against Tuberculosis, A. Calmette, Internat. J. Pub. Health, July, 1920, i, 3.*

Manitoba Sanatorium Report.—The annual report of the Manitoba Sanatorium for the year 1919 looks back to small beginnings a little less than ten years ago and finds satisfaction in a record of 2945 admissions, including 637 ex-soldiers. It is worthy of note that of the 409 patients discharged during 1919, 123 or 29 per cent are classed as nontuberculous. Among the civilian nontuberculous patients the most common diagnosis was "debility following acute respiratory disease." This was a very natural aftermath of the influenza epidemic which began in October, 1918. A few—chiefly members of staff—were treated for influenza and coryza. Other nontuberculous conditions were empyema, endocarditis, psychoses, exophthalmic goitre, asthma, pleurisy and bronchitis. Nontuberculous conditions among the soldiers were somewhat different. The largest number were classed as having bronchitis, chiefly subacute or chronic, and with or without definite emphysema. Among other conditions were bronchiectasis, pulmonary abscess, after-effects of gas poisoning, pleurisy with or without effusion, debility following acute respiratory disease, debility following severe wounds and anesthetics, empyema, coryza, chronic disease of antra and postnasal sinuses, pyorrhoea alveolaris, unhealed wound sinuses, wounds of the chest and valvular disease of the heart. The comparatively large number of nontuberculous patients admitted shows a definite use of the sanatorium as a place for diagnosis. In the preceding report of the same institution the superintendent, Dr. D. A. Stewart, gives as his opinion that one of the chief functions of the sanatorium is to be a clearing house for pulmonary diseases in general, as well as a place for the treatment of pulmonary and other forms of tuberculosis. A record is appended of prevailing weather conditions for the past five years. The highest temperature during 1919 was 95.7°, the lowest, −38.3°, a range of 134.0°. The mean temperature for the year was 33.65°. Bright sunshine during the past five years averaged 5.3 hours daily.—*Manitoba Sanatorium Annual Report for the Year Ending December 31, 1919.*

Antituberculosis Work in Suffolk County, New York.—The Country Tuberculosis Sanatorium was opened for the admission of patients in July, 1916, an administration and staff building completed in the fall of 1917 and a county tuberculosis nurse employed in February, 1918. Up to February 1, 1920, there were 262 admissions and 221 discharges. Of the patients, 168 were far advanced, 60 moderately advanced, 22 incipient, and 12 nontuberculous. On discharge, 31 were arrested, 41 quiescent, 42

improved, 29 unimproved and 78 died. The number admitted to the Suffolk Sanatorium represents only a small percentage of the cases in the county. A conservative estimate would place the number at over 1000. Assuming that the number of deaths (103) stated as due to tuberculosis in 1918 represents all those who died from the disease, Suffolk County has a mortality of about 94 per 100,000. This is comparatively low. The immediate needs in Suffolk County are: (1) Additional facilities for the sanatorium care and treatment of the tuberculous. (2) Provision for the care of tuberculous children. (3) Education of the public regarding tuberculosis. (4) Coöperation of all the physicians and others interested in preventive medicine and public health work.—*Tuberculosis and Some Phases of the Antituberculosis Work in Suffolk County, E. P. Kolb, Long Island M. J., May, 1920, xiv, 205.*

Housing and Tuberculosis.—The following are some methods to be used to improve the home conditions and occupational environment of our people: (1) There must be systematic health instruction in the public schools. The Pennsylvania State Department of Health purposes to furnish data on this subject to the Pennsylvania State Department of Public Instruction for a book to be used in the schools. A public health school is being organized which will be conducted by means of daily and weekly newspapers, on topics such as tuberculosis, school hygiene, milk, colds, and flies. It is not only important to teach people certain truths, but to see that they make practical use of them. (2) By the demand of the public many evils such as overcrowding, improper sanitation, and poor ventilation in public places can be eradicated. This can only be done by the public if we make known to them the evils in these conditions. (3) Greater efforts should be made in the establishment of fresh air schools. (4) Employers should be kept reminded of their duty to their employees. The British Royal Commission on Metalliferous Mines and Quarries found that dusts of silica, quartz, flint sandstone, carborundum and emery are injurious and employers should be made to protect their employees by using the proper sanitary apparatus where these minerals are used. T. C. Hall drew attention to the high death rate of steel grinders from pulmonary tuberculosis. (5) Health centers should be established in our cities where regular meetings will be held. At these meetings all social problems should be considered and plans made to better the existing conditions. Nutrition classes should be formed where children and mothers will be given lessons in sewing, planning meals and the care of babies. The Little Mothers League teaches girls to clothe, feed and bathe the baby. (6) It is important to constantly keep before the public, sick or well, the value of sunlight. (7) If we improve the most insanitary dwellings and neglect to improve the occupants of the house all our efforts are in vain. Sanitation of the house must go hand in hand with personal family hygiene. (8) Nature cannot cure tuberculosis unaided; therefore, a careful regulation of diet and every detail of the life of the consumptive throughout the twenty-four hours, by the combined forces of sanitation, nurse, and physicians, is necessary. (9) It is the duty of every physician to influence public opinion so that the evils incident to bad housing, occupational environment and sanitation may be improved.—*A Further Study of the Relation of Housing to Pulmonary Tuberculosis, F. F. D. Reckford, Am. J. M. Sci., August, 1920, clx, 259.*

The Costs of Tuberculosis.—Two life tables were made, the first taking into account all deaths, the second, ignoring the deaths from tuberculosis, but including the deaths from all other causes. The difference in these two tables shows how many years of life are lost to every individual because of the presence of tuberculosis. The figures are based on the population and deaths reported in the registration area in 1910. The area comprises twenty-one states and over half the population of the entire country. The object was to show what a death from tuberculosis costs the country. Persons below seventeen years of age were not included. The first table shows the number of future years which an individual may expect to live under present conditions of mortality and the second how many years one may live if tuberculosis did not exist. By applying the above computation to the men registered under the selective service act, the total number of years added to their lives amounts to 19,000,000 and the total cost to $2,000,000,000. Dublin has found that mortality from disease has been lowered through the nursing service and educational campaign of the Metropolitan Life Insurance Company. The death rate from tuberculosis was reduced one-third between 1911 and 1919. Life tables show that the eradication of tuberculosis carries with it a saving to the average human life of from two and one-half to three and one-half years with a corresponding increase in the wealth of the country amounting to billions of dollars. The second method of research is an effort to find out by specific cases just what tuberculosis costs in the individual community.

The group studied comprised 1362 individuals of which nearly all the men were married, more than half of the women were widowed, one-third of them having had husbands who died of tuberculosis. They lived under crowded and poor conditions. The average cost per family was $2017 of which $836 was in lost wages and $1181 in relief and care given by the association. These findings are offered in the hope that they will arouse a wish to do similar work in ones own community.—*Some Findings in Regard to the Economic Costs of Tuberculosis, Jessamine S. Whitney ,J. Outdoor Life, July, 1920, xvii, 193.*

The Industrial Colony and Tuberculosis.—The author advocates that farm colonies be established in conjunction with sanatoriums and hospitals for the after-care of consumptives. Some objections are offered by other physicians: (1) The plan is visionary. (2) Farm work is drudgery. (3) Experience has shown that consumptives do better when returned to their old occupations provided it is not of an injurious nature. (4) The eight hours of employment matters little provided the other sixteen hours are properly used. (5) Our attention should be directed to prevention of tuberculosis rather than methods of treatment. These objections are refuted: (1) We are only trying to bring about the adaptation of a practical weapon already proved to be successful. (2) Those who are not familiar with farming as it exists today, do not know that machinery has removed the drudgery. (3 and 4) Why these two objections should be twisted into an argument against reëducation or colonization plans the author cannot say. (5) We all realize that to eliminate tuberculosis we must lift civilization above its present level but in so doing we must also help the unfortunate victims. The examination of drafted men has shown: (1) Tuberculosis attacks the individual just at the point when he is beginning to enter actively into life. (2) Few men were established in any trade. Therefore the problem of reëducation is not difficult. (3) Patients in sanatoriums crave employment and home life. When a case of tuberculosis is discovered in a family, further examination will show other members infected; therefore the patient's desire for home life would be satisfied by allowing the whole family to live in this farm colony. A fair trial of the farm colony is suggested by the following reasons: (1) It will provide a better food supply at a lower cost. (2) It will relieve charity organizations. (3) It offers the widest and best opportunity for reconstruction. This plan gives the poor man a chance to change his climate as well as the rich man. The author has utilized the facts and plans set forth by H. A. Pattison.—*The Industrial Colony in the Campaign against Tuberculosis, A. M. Forster, J. Outdoor Life, July, 1920, xvii, 205.*

Tuberculosis and General Medicine.—Any medical department which does not make certain that every student has the opportunity to acquire some first hand knowledge of tuberculosis is failing in a very important duty. The hospital problem is closely connected with the question of the teaching of tuberculosis. If a hospital has no place for tuberculous patients there will be little opportunity for thorough study of this problem. Dispensary teaching is not sufficient for this purpose.—*The Separation of Tuberculosis from General Medicine, T. C. Brown, Health Bull. of Oklahoma, April, 1920, ii, 7.*

The Tuberculous Veterans.—A man who has contracted tuberculosis while in service is probably mutilated for life whereas a soldier with partial destruction of limbs can be rehabilitated by intensive training in some fit occupation. The author has drawn up a circular containing instructions for tuberculosis examinations which includes the essentials of a proper and thorough tuberculosis report. The rating of disability for tuberculosis has materially changed. The prevention of relapses depends on the physician to some extent, and it is his duty to give the ex-service man the proper vocational guidance and to rehabilitate him.—*The Tuberculous Veterans, J. L. Mandracchia, N. York M. J., June 26, 1920, cxl, 1112.*

Tuberculosis Eradication in Live-Stock.—In reviewing the live-stock laws and the rules and regulations of the respective states, we observe that for more than ten years practically every commonwealth required that before cattle could be introduced from other states for breeding and dairy purposes, they should be free from tuberculosis as determined by the tuberculin test and physical examination. It would seem that by such a restriction it would be well-nigh impossible for that disease to spread from one state into another. Unfortunately this expectation has not been realized. Of primary importance in the eradication of tuberculosis is the checking of the movement of diseased animals from state to state. At present there are about 400 state and federal employees engaged full time in the eradication of tuberculosis. They deserve much credit; but their number must be greatly increased in order to clean up tens of thousands of herds and thousands of counties.

The accredited-herd plan has stood the test of time and is worthy of the support of the individual veterinarian and all veterinary associations. All infected areas should be put in a little different status from disease-free areas. As rapidly as a territory is freed of tuberculosis, it should be designated as free territory, and the movement of cattle from that territory interstate, except cattle under local quarantine, should be permitted without restrictions so far as tuberculosis is concerned. The responsibility for eradicating tuberculosis from individual herds rests upon the owners and persons in care of such herds. If they approach the problem without decision, without determination, and without carrying out all the practices that are absolutely essential for success, they will fail.—*Tuberculosis Eradication: Its Aims, Methods and Ultimate Goal, J. A. Kiernan, J. Am. Vet. M. Ass., July, 1920, lvii, 439.*

Relation of Dust to the Spread of Tuberculosis.—Of 134 samples of dust taken from rooms where open cases of tuberculosis were being treated, twelve were positive. Of eighteen samples taken from the Cook County jail, three were positive. Seven positive cases were found in single and double rooms facing north, while only two were found in rooms facing south. The greatest percentage of positive samples was found in places where the greatest number of open cases were being treated. A suspension of tubercle bacilli in salt solution was killed in twenty minutes in direct sunlight with the sun's rays at an angle of fifty degrees, five hours in a film of dust in direct sunlight, five days in a south room, and seven days in a north room.—*Studies on the Relation of Dust to the Spread of Tuberculosis, H. C. Sweany and C. C. MacLane, Ill. M. J., December, 1919, xxxvi, 302.*

Viability of the Tubercle Bacillus in Dust.—Summary and conclusions: Experiment I shows that dust material containing living tubercle bacilli can withstand drying and the effect of diffuse light and still retain virulence, and in sufficient numbers produce tuberculosis in a guinea pig. The wards from which the samples of dust were taken are occupied by advanced, open cases of tuberculosis, many of these patients being of the middle and lower social strata. An attempt is made to prevent coughing with uncovered mouths and to observe other rules of cleanliness, but unless constantly watched, the rules are ignored. The ward floors are mopped daily with a strong solution of Neko (a coal-tar product with a phenol coefficient of 16 : 20) and, in some of the samples of dust and dirt collected, this could be detected by its odor. The bed clothes are changed daily, and it is our opinion that the cleansing of the wards is as thorough as is practical in public institutions. Theoretically, if the patients observe the rules carefully, the bacteria should not be scattered by the patients, but from the bare facts of the case, it would appear that it is extremely hard to prevent to some extent at least the scattering of the microörganisms. It emphasizes the importance or absolute necessity of housing advanced cases where this dissemination can be reduced to a minimum, and would suggest rather than prove that open cases of tuberculosis should not be admitted to the wards of a general hospital. Experiments II, III and IV indicate that blood and other organic matter coming from the body at postmortem, protect the organism from natural germicidal agents and that even in the process of sterilization, using strong solutions of Neko and phenol, a number of bacteria will escape and remain virulent and can be blown around in dust, be inhaled by guinea pigs and produce tuberculosis.—*Studies on the Viability of the Tubercle Bacillus, J. B. Rogers, Am. J. Publ. Health, April, 1920, x, 345.*

Respiratory Insufficiency of the Apex.—There exists a functional hypocapacity of the apex, usually bilateral, and usually associated with malformation of the bony frame of the chest, low index of vigor, anemia, asthenia and often adenoids. Not enough air gets into the apex. The region does not share in ample excursions, and the respiratory muscles and diaphragm are weak, the habits of breathing defective, but with careful examination the danger of mistaking this functional hypocapacity for tuberculosis can be avoided. Breathing exercises, the spirometer, and restoring the permeability of the nasopharynx will generally restore clinically normal conditions.—*L'insuffisance respiratoire des sommets et le diagnostic de la tuberculose pulmonaire chez l'adulte, E. Sergent, Bull. Méd., May 22, 1920, xxxiv, 469.*

The Anatomic Forms of Pulmonary Tuberculosis.—The basis of this classification of lesions rests upon the anatomic structure of the lung. All tuberculous lesions may be subdivided into either proliferative changes starting in the alveolar framework, leading to the formation of tuberculous granulation tissue; or exudative processes involving the air spaces. These rarely exist in pure state but are usually combined and the lesion is classified as one or the other process predominates. The proliferative type is characterized by the development

within the alveolar framework of proliferative tubercles which Orth has shown to be of fibroblastic origin. They present giant cells, central necrosis and peripheral lymphocytic reaction. The lesion spreads by direct extension and there is also a secondary increase in size due to inflammatory changes in the surrounding alveoli, a collateral and perifocal pneumonia. The process may heal by encapsulation with connective tissue. It is due to the effect of implantation of tubercle bacilli within the connective tissue. The second type of process, exudation within the air spaces, is characterized by a proliferation and desquamation of the alveolar epithelium which fills the lumina with large mononuclear cells. These may undergo massive caseation and the process is then known as caseous pneumonia. Frequently, according to A. Fränkel, Tripier, Orth and especially Ceelen, organization of such caseous exudate may result from the formation within the alveolar framework of granulation tissue either tuberculous or nonspecific. This process is known as tuberculous carnification. The exudative and pneumonic processes are generally due to the action of the tubercle toxin rather than to the bacillus itself. Aside from these main headings Schmincke classifies lesions according to their morphological appearance and their method of spread as miliary, nodular, and confluent types. The following distinct types are mentioned. *A. Lesions of hematogenous origin:* (1) Acute hematogenous disseminated miliary tuberculosis. This type is the result of a sudden rupture of a large number of bacilli into the circulation and characterized by the appearance of widely distributed small discrete tubercles situated in the stroma and parenchyma of the lung. The lesions are primarily proliferative but are later increased in size by collateral and perifocal pneumonic exudation. Those at the apex are larger than elsewhere, probably due to the slower circulation in this region which allows more bacilli to remain in the tissue. (2) Miliary caseous pneumonia, the miliary caseous hepatization of Virchow. The primary lesion is of an exudative nature and localizes within a single acinus and may then spread to involve adjacent acini. As a result there appear small nodular masses often shaped like clover leaves involving limited areas in the inferior portions of the lung. This type is most common in children. *B. Nodular tuberculosis*, usually spreading by way of the air passages: (1) Nodular proliferative form, due to proliferative lesions starting in the alveolar framework. Many such lesions may coalesce to form large nodules which frequently caseate. The intervening lung tissue may undergo a collapse induration, with a thickening of the collapsed alveolar walls and pigmentation due to secondary deposit of dust. (2) Nodular exudative form, due to a localized exudative process starting in the same location. Grossly the nodule is not so sharply defined, due to the absence of a well developed connective tissue capsule. Each of these processes tends to extend within the bronchioles toward the hilum, but during such spread the process becomes a mixture of exudative and proliferative reaction. It may extend through the wall of the bronchus to involve its outer layers with the formation of a peribronchial tuberculosis; it may spread still further to involve the nearby parenchyma. If caseation occurs over a considerable area of such involvement cavity formation results. By aspiration of caseous material into other portions of the bronchial tree new nodular exudative lesions are formed. These nodular types tend to invade vessels. Those of a proliferative nature often invade the lymphatics and set up local metastases. Frequently the exudative type involves perivascular lymphatics with an extension to the intima of the blood vessels and possible rupture into the circulation. *C. In the third group are the confluent process of both cirrhotic and pneumonic character.* (1) The first type is thought to be due to confluence of many nodular proliferative lesions involving an extensive area. The apical scars representing healed primary infections are probably of this origin. The type is characterized by a tendency to the formation of connective tissue which later retracts, resulting in deformity. Heavy pigmentation with dust and pleural adhesions are usual complications. Cavity formation is not infrequent and is often of bronchiectatic origin. (2) The confluent pneumonia type, galloping consumption or phthisis florida, may involve very large areas, even whole lobes. The parenchyma undergoes rapid softening with the formation of huge cavities; the stroma with its contained vessels and bronchi may persist as trabeculae traversing the walls and lumen of such a cavity. The vessels usually undergo thrombosis; if not, there is strong tendency to aneurysm and hemorrhage. The prognosis is unfavorable in all types except the nodular and confluent proliferative.—*Die anatomischen Formen der Lungentuberkulose, A. Schmincke, Münch. med. Wchnschr., April 2, 1920, lxvii, 407.*

THE

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ABSTRACTS OF TUBERCULOSIS

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Abstracts of Tuberculosis *will be published at intervals as an integral part of the* **American Review of Tuberculosis.** *It will receive separate paging and may, if desired, be bound separately at the completion of the volume.*

The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page

Correction: See p. 114, August, 1920, Review, Abstract Section.—Dr. Joseph Walsh has kindly called our attention to the fact that in the abstract, Classification of Pulmonary Tuberculosis, "(6) basal" should read "(6) obsolete."

Mortality from Tuberculosis in the United States, 1905–1919.—On the basis of an estimated population of 107,000,000 for the United States for the middle of 1920, it is reasonably probable that the number of deaths from pulmonary tuberculosis during the current year will reach 130,000 and from other forms of tuberculosis there will probably be 18,000 additional deaths. This estimate is based upon the average of the death rates of the registration area for the five years preceding 1919, which are sufficiently representative for the present purpose. There are no trustworthy data which would justify an estimate of the probable number of the living population infected with tuberculosis at the present time. It is merely conjecture to say that one case in ten terminates fatally, for clearly no one without a complete survey of the whole population is in a position to differentiate the infected element from those who are completely free from the tuberculosis taint. The number of such persons among our wage-earning population, however, must be enormous, and it probably is not going too far to say that one-tenth is potentially liable to fall a victim to the disease. For the United States the most useful data are the returns for large cities, with a population of approximately one-fourth of the total. The table below shows gratifying changes in the death rates since 1905, or, dividing the twenty-year period into four five-year periods, from 198.9 per 100,000 of population during 1900–04, and to 181.5 during 1905–09, to 158.9 during 1910–14, and to 145.1 during 1915–19. This reduction has been achieved regardless of truly extraordinary social and economic differences arising out of the Great War, the increase in the cost of living, the increase in the congestion of the population due to the falling off in the building of new homes, and, very broadly speaking, in the deterioration of the food supply, particularly of children and young adults. The tuberculosis death rate, which had been steadily diminishing since 1905, reached the lowest point on record since that date in 1913. The increase since that year to the end of 1918 is, of course, primarily attributable to the far-reaching consequences of the Great War

But the wholly unexpected and material reduction in the rate during 1919, or from 153.2 in 1918 to only 121.7 in 1919, cannot be considered otherwise than as measuring in part the direct effect of concerted and more strenuous associated methods of treatment and control.

Mortality from tuberculosis of the lungs in American cities, 1900–1919, by five year periods. (Rates per 100,000 of population.)

YEARS	AGGREGATE POPULATION	DEATHS FROM TUBERCULOSIS OF THE LUNGS	RATE
1900-1904	75,370,704	149,894	198.9
1905-1909	87,649,584	159,097	181.5
1910-1914	101,046,152	160,525	158.9
1915-1919	112,522,258	163,224	145.1

The data for Great Britain are not yet available for 1919, but the table following, derived from an article by Mr. Knud Stouman, in the *International Journal of Public Health*, will prove useful for the present purpose:

Mortality from tuberculosis of the lungs in Great Britain, 1909–1918. (Rates per 100,000 of population.)

YEAR	ENGLAND AND WALES	IRELAND	SCOTLAND
1909	109.1	183.5	127.4
1910	101.5	171.6	114.1
1911	108.4	173.0	114.7
1912	104.7	170.0	111.9
1913	101.2	168.2	107.9
1909-1913	105.0	173.3	115.2
1914	104.0	163.5	103.6
1915	117.9	174.0	110.6
1916	120.4	168.1	106.3
1917	127.9	173.9	104.5
1918	137.6	172.5	106.8

The foregoing table is limited to pulmonary tuberculosis and shows that the death rate since 1914 for England and Wales increased 33.6 per 100,000 of population; for Ireland, 9.0, and for Scotland, 3.2. The decrease for American cities during 1914–1918 was 1.4 per 100,000 of population. Mr. Stouman gives the returns for twenty-six principal Italian cities, for which the pulmonary tuberculosis rate increased from 166 per 100,000 of population in 1914 to 255 in 1918, or 89.0 per 100,000.

For the city of Paris the returns are of exceptional interest in that they include the year 1919 and are for "other forms" of tuberculosis as well as pulmonary tuberculosis. The statistics for the last six years are shown in the table below:

Mortality from tuberculosis in the city of Paris, 1914–1919. (Rates per 100,000 of population.)

YEAR	PULMONARY	OTHER FORMS	YEAR	PULMONARY	OTHER FORMS
1914	9391	1518	1917	8424	1559
1915	9070	1544	1918	8338	1334
1916	8756	1501	1919	7090	1352

This table is in curious contrast in that the mortality from pulmonary tuberculosis is shown to have actually decreased every year since 1914, or from 9391 deaths in 1914 to 7090 in 1919. A similar reduction occurred in the mortality from other forms of tuberculosis, or from 1518 deaths in 1914 to 1352 in 1919. How far this actual reduction is to be attributed to a diminution in the population as the effect of the war cannot at present be stated.

International statistics of tuberculosis require to be used with extreme caution No explanation, for illustration, has been forthcoming as to why the pulmonary tuberculosis death rate of the United States should be persistently above the corresponding rate for England and Wales, nor, conversely, why the mortality from bronchitis should be approximately more than five times as common in England as in this country.[1] How far this is a question of accuracy in diagnosis does not fall within the present discussion but it may be said that there has always been a lamentable indifference to precise accuracy in the diagnosis of industrial lung disease, probably not tuberculous in many cases, where lung fibrosis prevails primarily as in the case of quartz miners and granite stone cutters. The danger of generalizing from such data was forcibly illustrated by the original report by Dr. Hermann M. Biggs, on the extent of tuberculosis in the French army, given as 86,000 affected soldiers in December, 1915, and estimated for February, 1917, as 150,000, although subsequent investigations fortunately proved a very much lesser degree of prevalence than was originally implied by statistics of an apparent degree of intrinsic trustworthiness

[1] Male rate 20.9, for the United States, against 106.1 for England and Wales (1908–12).

Mortality from tuberculosis of the lungs in American cities, 1910-1919 (rates per 100,000 of population)

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Atlanta, Ga	263.7	244.9	269.1	214.1	239.4	238.7	233.1	167.0	175.3	162.9	182.1	173.8	132.9	140.0	120.1	115.9	122.3	118.8	111.8	102.0
Baltimore, Md	235.4	238.5	222.2	225.6	255.6	233.7	241.9	238.8	226.9	228.7	228.5	208.0	205.9	195.4	187.4	177.2	178.1	184.7	190.5	143.7
Birmingham, Ala	.....	.....	.....	.....	.....	.....	.....	.....	211.6	237.4	278.1	223.0	195.3	211.1	232.6	199.4	197.5	199.3	183.3	143.3
Boston, Mass	249.6	234.4	212.3	205.1	215.8	200.7	195.6	182.9	169.6	158.5	172.5	154.9	158.0	151.5	146.7	144.8	153.0	157.7	165.1	139.0
Bridgeport, Conn	186.6	225.8	162.5	164.8	182.5	192.0	160.9	175.8	146.2	141.6	179.3	108.3	85.2	82.2	95.4	116.6	113.6	146.8	139.3	137.3
Buffalo, N. Y	113.2	126.8	117.6	122.0	135.7	129.7	125.2	123.5	127.4	127.4	124.6	122.7	123.1	133.8	142.1	137.0	141.4	150.0	153.6	105.1
Cambridge, Mass	248.1	222.6	198.7	174.3	196.2	180.2	169.4	235.4	264.3	271.1	246.1	169.0	179.6	189.2	173.4	190.4	181.2	191.5	205.5	161.5
Chicago, Ill	165.4	147.9	148.2	160.1	166.8	166.2	162.4	171.5	163.0	155.9	159.0	148.1	145.4	135.8	146.4	152.9	132.9	133.2	128.8	105.5
Cleveland, Ohio	126.9	106.5	114.4	127.2	137.5	117.2	118.8	125.3	119.0	109.7	127.9	128.5	113.3	112.6	113.6	111.1	126.9	144.5	144.6	108.8
Columbus, Ohio	208.8	203.5	191.2	209.7	204.9	189.0	198.7	181.5	172.0	155.3	178.5	159.3	146.4	138.3	137.9	132.4	125.2	137.9	139.4	107.1
Dayton, Ohio	170.9	193.4	181.2	183.6	190.6	191.4	204.3	181.6	186.8	191.1	162.1	141.3	129.0	140.9	114.1	141.3	111.6	129.7	128.4	90.6
Denver, Col	373.4	378.7	373.9	366.1	396.2	386.5	370.5	354.2	365.5	341.8	303.7	275.6	281.6	257.2	257.2	253.8	217.0	245.2	312.8	246.0
Detroit, Mich	113.1	110.3	115.7	107.6	118.1	102.0	107.3	97.4	91.3	86.1	99.8	93.9	87.5	82.2	80.2	90.2	104.1	102.0	109.1	80.2
Fall River, Mass	184.4	154.2	173.9	184.1	212.2	146.9	134.9	156.7	131.1	129.8	142.5	139.8	128.8	132.9	153.6	120.1	172.5	155.7	189.6	111.3
Grand Rapids, Mich	93.6	96.0	100.4	114.2	120.9	74.9	82.6	93.7	76.3	86.1	102.2	87.8	77.4	55.0	68.5	85.5	65.0	80.7	86.7	53.3
Indianapolis, Ind	220.5	180.1	165.4	188.3	210.8	170.4	172.7	203.4	193.9	182.0	179.8	153.1	151.7	179.2	171.5	168.7	156.0	155.5	150.6	117.9
Jersey City, N. J	251.4	217.8	208.4	228.2	259.4	202.7	228.3	234.6	209.9	169.0	177.0	169.9	146.5	138.7	146.5	153.5	153.9	145.8	136.7	109.5
Los Angeles, Cal	357.1	321.1	300.1	361.8	280.1	312.0	299.4	288.3	230.7	226.3	232.8	247.4	234.6	243.1	209.1	201.9	188.6	192.9	206.6	176.2
Louisville, Ky	206.9	198.4	185.9	218.9	246.5	236.5	210.0	202.7	194.2	196.0	222.8	212.9	186.2	165.0	190.5	171.3	165.7	160.6	191.2	142.0
Lowell, Mass	192.7	166.4	164.3	135.9	141.2	153.3	153.4	152.9	121.2	119.6	112.9	116.9	119.0	91.5	97.5	104.2	106.4	136.5	143.8	87.6
Memphis, Tenn	242.1	223.0	259.3	190.2	235.2	251.7	216.9	206.8	223.9	231.9	250.9	218.3	225.0	242.7	272.3	261.0	236.2	241.9	260.1	162.0
Milwaukee, Wis	138.4	133.9	102.1	127.6	141.4	133.5	130.3	114.3	110.7	100.6	116.1	100.5	87.6	92.3	96.0	86.2	81.2	87.5	88.1	70.2
Minneapolis, Minn	128.3	120.2	106.4	118.8	103.5	92.9	101.6	103.6	107.0	123.0	121.8	134.5	119.5	119.0	117.1	128.8	122.7	124.7	116.8	103.1
Nashville, Tenn	346.0	266.6	311.0	246.2	346.9	324.9	283.8	244.5	212.0	193.3	212.0	203.3	194.7	175.6	204.3	204.6	155.4	180.3	203.9	150.6
Newark, N. J	250.7	227.8	225.9	244.2	248.0	240.2	247.7	231.7	208.7	191.7	215.3	184.3	152.3	154.7	163.3	168.5	153.2	155.1	135.6	135.0
New Haven, Conn	187.5	192.2	186.0	162.9	161.0	154.3	160.0	186.0	145.0	175.6	147.4	123.8	101.9	112.5	110.3	88.5	94.8	124.9	121.9	65.2
New Orleans, La	342.2	305.0	323.8	314.8	335.1	312.2	276.4	298.7	260.3	219.2	266.9	242.8	245.7	235.9	272.6	267.3	261.6	291.8	288.0	212.2
New York, N. Y	241.9	228.8	207.8	211.6	220.4	210.4	214.0	205.8	196.6	185.6	186.3	184.8	177.8	176.0	180.2	176.0	164.4	170.6	164.2	133.6
Oakland, Cal	192.9	217.0	171.4	140.0	109.0	112.3	175.5	201.7	141.8	155.3	127.2	104.6	118.1	110.0	104.7	117.3	98.5	93.6	98.0	134.4
Paterson, N. J	206.3	183.2	176.4	169.7	208.6	176.3	204.1	152.3	135.4	153.3	164.0	172.2	118.3	136.8	118.0	127.0	138.1	131.8	144.2	100.1
Philadelphia, Pa	217.9	210.9	198.4	216.2	230.4	203.4	225.1	220.8	201.7	189.0	194.1	194.0	170.5	165.0	167.6	164.1	170.2	174.3	191.8	143.8
Pittsburgh, Pa	120.5	129.2	131.0	136.9	149.5	149.1	126.2	112.4	114.2	109.0	104.5	106.6	101.5	108.0	111.0	110.5	113.2	131.7	138.2	105.3
Portland, Ore	113.9	116.9	103.3	105.8	102.0	89.2	80.7	91.8	91.4	81.7	84.0	88.1	76.8	71.4	70.3	78.6	72.3	63.4	82.2	67.1
Providence, R. I	236.3	217.5	213.2	214.3	187.6	169.8	163.4	156.5	151.7	137.2	154.2	132.0	115.2	129.1	121.6	125.6	134.1	140.1	128.0	121.6
Richmond, Va	307.6	248.4	253.7	259.8	263.6	222.7	266.5	238.9	194.3	209.2	224.1	209.7	212.2	169.7	188.3	175.2	187.0	162.6	185.4	153.6
Rochester, N. Y	143.9	149.2	110.6	125.6	140.5	147.3	142.1	125.6	132.8	135.7	138.0	112.0	94.1	95.3	89.5	98.1	89.9	92.1	97.0	69.4
San Francisco, Cal	283.6	289.5	278.7	281.5	265.1	264.1	176.3	175.5	179.7	166.9	185.7	158.4	161.3	161.6	178.2	177.2	166.4	157.4	169.6	151.8
Scranton, Pa	98.8	91.5	86.4	99.7	103.5	89.8	71.9	81.7	80.0	84.6	90.9	101.8	78.4	80.2	81.2	77.7	81.0	76.8	89.6	67.2
Seattle, Wash	110.2	106.8	98.4	90.9	94.1	71.3	64.7	79.1	79.3	88.1	96.1	95.1	85.4	81.7	77.8	58.6	67.5	71.8	66.7	63.0
Spokane, Wash	109.7	119.3	118.4	132.0	105.9	91.9	95.0	92.6	103.0	87.5	90.0	92.0	65.2	83.4	70.0	70.0	58.5	72.9	61.4	47.0
St. Louis, Mo	187.1	192.3	181.4	187.2	231.7	222.5	195.2	172.4	170.2	177.0	167.2	137.3	138.2	140.6	147.6	131.6	132.3	142.9	129.1	92.1
St. Paul, Minn	120.8	120.7	101.7	94.3	105.7	112.5	100.0	121.7	92.7	106.2	111.3	113.0	107.9	121.9	120.8	114.4	108.1	126.4	115.8	103.2
Syracuse, N. Y	157.8	158.9	118.0	131.1	146.5	120.0	120.2	118.7	119.3	111.1	93.3	96.7	89.5	99.6	106.6	84.8	86.8	88.0	92.9	49.9
Washington, D. C	292.7	295.3	245.0	264.7	277.3	272.2	251.5	242.8	221.4	229.4	234.4	215.4	213.1	198.4	171.8	186.3	172.7	154.4	161.7	131.9
Worcester, Mass	206.0	191.9	165.2	170.6	168.0	170.9	154.2	149.3	149.8	118.1	104.1	115.8	107.8	104.6	119.2	114.6	133.5	129.4	122.0	95.5
Average	209.8	199.4	187.5	193.7	204.4	192.5	189.5	185.8	174.7	167.3	172.2	162.9	154.1	151.6	154.0	152.5	147.0	152.0	153.2	121.7

The present investigation, limited to forty-five American cities, will facilitate the practical use of available data, the details being given for each year since 1900 and in a consolidated form by five-year periods. The suggestions regarding the necessity of caution in the use of international tuberculosis statistics apply, though in a lesser degree, to a comparison of individual cities. It is always best to limit the comparison to the city itself, for its own record for a given period of time is most useful for practical purposes. It is very easy to draw false conclusions from comparative statistics not standardized on account of wide variations in the age and sex distribution and the occupational activities of the population concerned. It is safe to assume, however, for illustration, that the low figure for the city of Spokane, Washington, is in conformity to the facts of a decidedly low rate of local frequency occurrence, due to causes as yet but imperfectly understood. In this connection attention may be directed to the truly admirable local provision for the treatment of the disease at the Edgecliff sanatorium, which reflects the health progress of the community as well as the sanitary and humane ideals of its citizenship. —*Mortality from Tuberculosis, 1905–1919, F. L. Hoffman, The Spectator, Life Insurance Section, September 23 and 30, 1920.*

	1900–04	1905–09	1910–14	1915–19
Atlanta, Ga	245.5	193.7	148.9	114.0
Baltimore, Md	235.5	233.9	204.5	174.5
Birmingham, Ala	.....	.....	227.4	183.8
Boston, Mass	223.2	180.9	156.6	151.9
Bridgeport, Conn	183.9	162.5	108.6	129.0
Buffalo, N. Y	123.2	126.6	129.5	137.3
Cambridge, Mass	207.6	224.9	191.4	186.0
Chicago, Ill	157.8	163.7	146.8	130.3
Cleveland, Ohio	122.8	117.9	118.8	126.3
Columbus, Ohio	203.6	178.7	151.5	128.2
Dayton, Ohio	184.0	191.0	136.9	119.9
Denver, Col	378.0	363.0	274.6	255.2
Detroit, Mich	113.0	96.2	88.3	96.9
Fall River, Mass	181.8	139.7	139.5	149.8
Grand Rapids, Mich	105.4	82.8	77.7	74.1
Indianapolis, Ind	192.8	184.7	167.1	149.2
Jersey City, N. J	233.2	208.4	155.5	139.7
Los Angeles, Cal	320.8	267.2	232.7	192.9
Louisville, Ky	211.5	207.7	195.4	166.1
Lowell, Mass	160.1	139.6	107.5	115.7
Memphis, Tenn	229.8	226.2	242.1	231.5
Milwaukee, Wis	128.7	117.3	98.3	82.5
Minneapolis, Minn	114.9	106.0	122.2	119.0
Nashville, Tenn	303.2	246.9	197.9	178.9
Newark, N. J	239.4	222.8	173.5	149.2
New Haven, Conn	177.6	164.3	118.8	99.0
New Orleans, La	324.2	272.7	252.8	264.0
New York, N. Y	221.7	202.0	181.0	161.5
Oakland, Cal	162.7	158.5	112.6	108.6
Paterson, N. J	188.8	163.7	141.6	128.2
Philadelphia, Pa	214.9	207.8	178.0	168.8
Pittsburgh, Pa	133.7	120.6	106.4	120.6
Portland, Ore	107.7	86.9	77.9	72.7
Providence, R. I	213.3	155.3	130.1	129.8
Richmond, Va	266.4	224.8	200.5	172.7
Rochester, N. Y	133.8	136.4	105.0	89.0
San Francisco, Cal	279.5	191.8	169.0	164.3
Scranton, Pa	96.1	81.6	86.4	78.4
Seattle, Wash	99.0	77.7	86.9	65.5
Spokane, Wash	117.2	94.0	80.1	62.0
St. Louis, Mo	196.3	187.1	146.1	125.4
St. Paul, Minn	108.8	106.6	115.0	113.5
Syracuse, N. Y	142.3	117.8	97.3	80.2
Washington, D. C	274.8	243.1	205.8	160.8
Worcester, Mass	180.0	147.9	110.4	118.8
Average	198.9	181.5	158.9	145.1

Modern Outlook on the Treatment of Tuberculosis.—Philip discusses the general status of the tuberculosis problem at the present time and the outlook for the future. He comments particularly upon the present hopeful attitude considering the curability of tuberculosis as shown by the fact that more persons recover than ultimately die from this disease. The traditional portraiture of phthisis by Hippocrates and later masters in clinical medicine has so commanded attention as in some ways to constitute a bar to the recognition of the early stages of this disease. He objects, and rightly, to the term "pre-tuberculous." He likewise calls attention to the striking analogy between tuberculosis and syphilis. The primary lesion in tuberculosis is often impossible to find owing to the fact that the bacillus passes through the normal, healthy mucous membrane, leaving no trace. Following this, there succeeds a period of latency, again followed by lymphatic involvement. He emphasizes the importance of systemic intoxication in the diagnosis of this condition. In the future, there will not only be a decrease in the death rate, but also a lessened morbidity.—*Modern Outlook on the Treatment of Tuberculosis, R. Philip, Edin. M. J., July 1920, xxv, No. 1.*

Deaths and Death Rates from Pulmonary Tuberculosis in New York City and State. The following tables, showing the deaths and death rates from pulmonary tuberculosis for New York City and State, for June and July, during the years 1913 to 1920, inclusive, are taken from the *Monthly Vital Statistics Review, New York State Department of Health, August and September, 1920, New Series, vol. i, nos. 6 and 7.*

Pulmonary tuberculosis: Deaths and death rates, New York State and large subdivisions. June 1913 to 1920*

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
June...	1913-17	1,183	142.3	699	155.5	484	126.9	241	130.2	243	123.8	....	....
June...	1913	1,146	143.4	662	154.9	484	130.1	232	128.1	252	132.7	....	....
June...	1914	1,222	149.8	712	162.8	510	135.7	230	124.4	280	147.1	....	....
June...	1915	1,170	140.8	705	156.9	465	121.9	248	134.0	217	110.5	....	....
June...	1916	1,157	137.0	697	151.7	460	119.5	229	122.2	231	116.9	....	....
June...	1917	1,219	141.4	719	152.9	500	128.4	267	140.1	233	116.5	....	....
June...	1918	1,149	131.2	654	135.9	495	125.6	232	119.5	227	112.9	36	....
June...	1919	1,073	120.1	621	126.1	452	113.3	186	94.0	221	109.3	45	....
June...	1920	903	99.6	494	98.2	409	101.4	144	72.0	227	111.5	38	....

* Deaths per 100,000 population per annum.

Data from New York State Health Department Annual Reports and Monthly Bulletins, or specially computed.

Pulmonary Tuberculosis: Deaths and death rates, New York State and large subdivisions, July, 1913 to 1920

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
July....	1913-17	1,084	126.3	664	143.0	420	106.6	202	105.6	218	107.4	....	....
July....	1913	1,069	129.3	660	149.5	409	106.4	199	106.4	210	107.0	....	....
July....	1914	1,101	130.7	668	147.9	433	111.5	192	100.5	241	122.5	....	....
July....	1915	1,103	128.4	702	151.1	401	101.7	206	107.7	195	96.1	....	....
July....	1916	1,007	115.4	604	127.2	403	101.3	207	106.9	196	96.0	....	....
July....	1917	1,140	127.9	684	140.7	456	113.2	208	105.6	248	120.0	....	....
July....	1918	1,015	112.2	606	121.7	409	100.3	175	87.2	191	91.9	43	....
July....	1919	995	107.8	590	115.9	405	98.2	148	72.4	215	102.9	42	....
July....	1920	828	88.3	479	92.0	349	83.7	127	61.4	184	87.5	38	....

Coöperative Tuberculosis Work in Italy.—Because of the sudden need of soldiers in France in 1914, it was impossible to separate tuberculous soldiers from the rest. There was also little room in the hospitals for the tuberculous soldier. The result was that the American Red Cross and the Rockefeller Foundation came to the rescue by sending commissions to coöperate. In time these commissions reached Italy. The members of the commission had to study the foreign languages and problems such as housing, child welfare, and child labor. Nineteen towns ranging from Naples to Piperro were selected for the work. In every case the prerequisite was an Italian committee of volunteers which was willing to coöperate. Each locality was carefully studied and plans for hospitals, open-air schools and teaching of general hygiene were formulated and adopted. There are many interesting pieces of work going on in Italy. Northern Italy has kept pace with other countries, but southern Italy needs roads, railroads, aqueducts, houses, water power, instalment of drainage and planting of trees. Above all, southern Italy needs new and better schools. Italy cannot at present better conditions without the help of America and England. This is a splendid chance for a step toward international coöperation.—*Coöperative Tuberculosis Work in Italy, W. C. White, Tubercle, September, 1920, i, 550.*

Public Health Training Course in Tuberculosis.—The United States Public Health Service, which for some time has been making special efforts to facilitate the diagnosis of tuberculosis and especially to bring about its recognition in its very earliest stages, has recently opened mobile training courses for the purpose in Illinois, Wisconsin, Michigan, and Washington. Similar courses have already been given in Texas, Louisiana, Missouri, Virginia, West Virginia, Maryland, and Pennsylvania. These courses, which last seven days and are very intensive, are at present open only to physicians attached to the Public Health Service; but after all of these in the various States have completed the course it is hoped that it may be possible to hold similar courses for the benefit of other physicians who may desire to attend. The instruction is given by recognized experts in the diagnosis of pulmonary tuberculosis, and is supplemented by the showing of a remarkable motion picture, in six reels, which minutely illustrates every phase of the disease.—*From Health News, issued by the U. S. Public Health Service.*

A Plea for a Tuberculosis Department in Medical Schools.—Massachusetts spends $3,000,000 annually for the care of tuberculous patients, but there is a widespread feeling that the government is not getting a satisfactory return on the money expended in its efforts to stamp out pulmonary tuberculosis. The best minds in tuberculosis work place the failure to secure better results upon the delay or inability of the general practitioner to recognize the signs and symptoms of early pulmonary tuberculosis. Hawes says that in the majority of our leading medical schools the subject of tuberculosis receives scant attention. With an early diagnosis 60 to 80 per cent of the cases could recover. With this fact in view, it is not surprising that a plea for the creation of a tuberculosis department in the medical schools is made. The general practitioner is our first line of defense in all invading illness. For men who are now engaged in general practice, the Department of Public Health proposes a series of consultation clinics in pulmonary tuberculosis. These clinics will be conducted by physicians attached to the state sanatoria and the family physician will be able, without price, to obtain expert diagnosis in his tuberculosis case. In addition to this, it is planned to demonstrate the case in detail to the family physician. History taking, methods of making physical examinations, interpretation of physical signs as well as interpretation of the symptoms revealed by the history of the case will be thoroughly discussed.—*A Plea for a Department of Tuberculosis in Medical Schools, W. J. Gallivan, Boston M. & S. J., September 16, 1920, clxxxiii, 348.*

Nutrition Clinics and Tuberculosis.—Nutrition classes have been carried on with children at the out-patient department of the Boston Consumptives' Hospital. The aim has been to get these children well in their own homes by means of instruction in these classes. The problem of tuberculosis is for the most part one of nutrition. If children can be made well in a sanatorium, they get health; but if they can be made well in their own homes, they get health, plus health education, plus character. Nutrition work, which covers a new and hitherto neglected field in medical work, must be carried on with proper authority. It cannot fit in as an adjunct to other programs, but other programs must be adjusted to fit the problem of tuberculosis. It was shown in the work during the year that children cannot only be made to come up to the normal rate of gain but double it even under discouraging circumstances. With the proper

coöperation of the four factors that safeguard the child's health, namely, the home, the medical work, the child's own interest and the school, all these children should rapidly be brought up to normal health. To bring sick children up to normal health is an opportunity for rehabilitating the whole family and adjusting it to its proper relation in the community.—*Nutrition Clinics and Tuberculosis, W. R. P. Emerson, Boston M. & S. J., September 16, 1920, clxxxiii, 361.*

Disposition of Tuberculosis in Industrial Organizations.—The three main problems in dealing with industrial tuberculosis are: (1) The elimination of tuberculosis from the organization by medical examination of all applicants and periodic reëxaminations of employees. (2) The protection of others against infection by the usual accepted methods. (3) The care and disposition of tuberculous employees, the objects in view being: a. To secure recovery and return to work. b. Failing in that, to rehabilitate as far as possible and secure proper living conditions. c. To care for advanced cases. An attempt has been made to set forth the following: (1) That where possible, a standard method of procedure should be adopted in caring for cases of tuberculosis in industry. (2) That the procedure should be adapted to the needs of lay executives and based on economic progress. (3) That cases in the earliest stages, including those only suspected of having the disease, should be constantly sought for and at once put under treatment in rest homes with a view to early and permanent recovery. (4) That such cases should not be stigmatized as having tuberculosis. (5) That many cases in which the economic prognosis is poor, are cared for better and more cheaply at their homes than in institutions.—*Disposition of Tuberculosis in Industrial Organizations, J. S. Billings, J. Industr. Hyg., July, 1920, ii, 90.*

Tuberculosis Control amongst Herds in Pennsylvania.—To eradicate bovine tuberculosis it is necessary to remove all diseased animals from an infected herd. This can be accomplished most thoroughly by the combined tuberculin tests, namely the subcutaneous, conjunctival and intracutaneous, in preference to the subcutaneous test alone. As a concrete example, a herd of 100 cattle was tested by the subcutaneous method, when 39 reacted and 13 were suspicious. The balance of the herd including calves and suspects, or a total of 74 animals, were retested by the combined method. The 13 suspects reacted, as well as 21 others that were negative to the initial test. All but 4 were slaughtered and all showed lesions. Before adding any new cattle to the herd, these should be isolated and subjected to at least 2 successful tuberculin tests to prevent infecting the healthy herd. The records for the past five years show an average of 9 per cent reacting as compared to 17 per cent for a similar period at the beginning of the Board's existence. The accredited plan of the State also includes disinfection of infected premises, isolation of added cattle until two successful tests have been passed, enforcement of rules regarding sanitation, attention to the calves, etc. In other words, herds are freed in the shortest possible time, and after they become healthy every precaution is taken to keep them healthy.—*Tuberculosis Control in Pennsylvania, S. E. Bruner, J. A. Vet. Med. Ass., September, 1920, lvii, 705.*

Osler's Work in Tuberculosis.—An account of the great physician's interest and activities in tuberculosis and a bibliography of his contributions to the subject. Much of this has already appeared in the REVIEW, February, 1920, iii, 745.—*Tuberculosis and the Life and Work of Sir William Osler, S. A. Knopf, Brit. J. Tuberc., July,* 1920, *xiv*, 97.

Preventorium for Vermont.—Vermont is to have a new preventorium. On March last, the sum of $50,000 and 25 acres of land were offered the Vermont Tuberculosis Association for the erection of a much-needed preventorium for children by Mr. Redfield Proctor and his sister, Miss Emily Dutton Proctor. The donation was made on condition that the Association raise an equal amount of $50,000 for its general work, and that the new preventorium be a memorial to the late Dr. Charles S. Caverly. Following the offer, the Vermont Association conducted an intensive drive for funds, with the gratifying result that considerably more than the amount asked for was collected. The long-hoped-for preventorium is thus assured of becoming a reality in the near future.—*Bull. Nat. Tuberc. Ass., September, 1920, vi, 4.*

Massachusetts Tuberculosis Clinics.—The State Department of Public Health announces to the physicians of Massachusetts a series of consultation clinics in early pulmonary tuberculosis. These clinics will be conducted by the medical staffs of the State sanatoriums, and opportunity will be afforded the family physician to obtain, without fee, expert diagnosis in this type of pulmonary disease. Patients applying to these clinics must be accompanied by the

family physician, or present a letter from him giving the history of the case and requesting an opinion. These clinics will begin in September, 1920. Facilities for consultation are provided at each State sanatorium for every day of the week (Saturdays, Sundays and holidays excepted) between the hours of 2 and 5 o'clock. Attendance at these clinics is not restricted to the inhabitants of their own cities. Physicians are invited to make use of any clinic, it being inferred that they will select the one nearest their home city or town.—*From a circular letter from the Commissioner of Public Health to the physicians of Massachusetts, August 24, 1920.*

Putting the Ex-Consumptive Back on the Job.—The Federal Vocational Board and the National Tuberculosis Association are coöperating with the New York Tuberculosis Association in the management of a workshop and training school for the industrial rehabilitation of ex-service men convalescent from tuberculosis whose disease has reached the arrested stage. Later on, when the shop has become self-sustaining, others than ex-service men will be received. The shop is incorporated under the name of the Reco Manufacturing Company, Inc., and is located at 458 Pierce avenue, Long Island City, in a large, airy, well-lighted loft with lunch room and other conveniences. Medical care and treatment are at hand in any emergency. The object is to gradually and safely teach a trade that will not be injurious and, in which, after the men have learned to make marketable goods, they will be paid the same wages as others doing the same work. An opportunity is thus offered to learn one of the following skilled trades under instruction of experts, viz.: 1. Watch repairing. 2. Jewelry manufacturing (gold and platinum). 3. High class cabinet making. As soon as a man learns to make goods that can be sold or repairs that are paid for, he will receive the regular union wage for that particular kind of work. This training does not in itself affect any compensation he may be now receiving from the Government. This is a great chance, for the workshop can teach a trade that is well paid, and when a man learns it, he can maintain his health and support not only himself but also his family. The wages earned by cabinet makers, jewelers and watch repairers range between $40 and $75 per week. There is a great demand for skilled workers in all these trades throughout the United States. The workshop is now open. To apply for admission, men must come in person to the New York Tuberculosis Association, 10 East 39th Street, New York City (third floor). Many of the physicians in New York City have such ex-service men convalescent from tuberculosis under their care. If they feel that such work, as is described above, will be beneficial to their patients, they are urged to advise them to make application for admission to this training school.—*Weekly Bull., Dept. of Health, N. Y. City, September 4, 1920, ix, 283.*

The London Scheme for the Prevention of Tuberculosis.—Very little progress has been made in London in the treatment and prevention of tuberculosis, if we consider the financial outlay in the past years. Persons who do not come within the scope of the Poor Law have available for them sanatorium, dispensary, and domiciliary treatment. It is apparent that in this scheme there is wofully lacking the following units of a properly coördinated system: 1. Open-air schools run in conjunction with the dispensaries as a preventorium or for children returning from a sanatorium. 2. Farm colonies and working centres in order to continue the salutary effects derived at the sanatorium and to train a man so that he may find it possible to earn a living under suitable conditions. 3. Hospitals for tuberculosis, both for the observation case and the advanced case in order to ensure accommodations in the sanatoriums for definitely curable cases only, and to prevent advanced cases from disseminating the disease in their homes.—*A Criticism of the London Scheme for the Prevention of Tuberculosis, G. H. Dart, Brit. J. Tuberc., April, 1920, xiv, 64.*

Tuberculosis Activities of the American Red Cross in France.—The Bureau of Tuberculosis and Public Health of the American Red Cross was created in August, 1917, and undertook to facilitate the completion of tuberculosis projects which would, owing to the exigencies of war, either have been abandoned or postponed. The following activities were engaged in: 1. The departmental survey of all tuberculosis activities. 2. The amelioration of conditions in existing tuberculosis institutions by improvising and completely equipping sanatoriums, thereby supplementing the shortage of beds at that period. 3. The subvention of dispensary construction and their operation—106 in all. 4. The subvention of hospital and sanatorium construction and operation, 2712 new beds being maintained. 5. The conversion of suitable premises into sanatoriums, thus furnishing 888 additional beds. 6. The subvention of popular educational propaganda. 7. The subvention and assistance in special fields

of work as Serbian relief and the French Red Cross. 8. Coöperation with the A. E. F. in the preparation of tuberculosis propaganda. 9. The organization and operation of a Hospital Admission Bureau and Social Service in the Paris Hospitals.—*The Rôle of the American Red Cross in the Tuberculosis Campaign in France During the Great War, E. G. Davies, Brit. J. Tuberc., July, 1920, xiv, 120.*

Annual Report, New York Association of Tuberculosis Clinics.—This association was formed in 1907 with only 8 clinics in Manhattan and the Bronx, whereas now there are 30 clinics extending over the entire city. They have had under their care in 1919, 43,000 patients requiring a total of 128,000 dispensary visits. In addition, trained nurses have made 57,000 calls to their homes, giving the personal attention necessary. About 17,000 children exposed to tuberculosis were kept under observation. Such constant and purposeful efforts as those of the association, year in and year out, must be in this city one of the most potent forces for the control and reduction of tuberculosis as well as assuring a stronger and healthier future generation.—*Year Book of the New York Association of Tuberculosis Clinics and the Annual Report for 1919.*

Annual Report of the Trudeau Sanatorium Medical Board.—Since the armistice soldiers and sailors have been admitted to the institution. On admission of the patients, they are sent to the Medical and Reception Pavilion, or to the Rest Squad. Those in the Rest Squad go to bed for six weeks and those in the Medical Pavilion go to bed if they have previously been in bed; if not, they are permitted to go to meals but take no other exercise. A complete history of each patient is taken and a month later is checked up by another physician. Chest examinations are made every month. The lungs are examined by the fluoroscope and X-ray plates, and tuberculin is given. Sputum and blood tests are performed. From 2.5 to 3 per cent positive Wassermann reactions are found. The adrenalin test has been a routine measure for several years. The commonest complication of fatal pulmonary tuberculosis is intestinal tuberculosis. The protein sensitization test is used in patients whose state suggests this condition. The urine is studied from month to month and blood counts made when necessary. Careful dental examinations are included. The patient can consult a nurse or physician at any time. Organized entertainment is furnished the patients. Once a week the entire staff makes rounds and endeavors to discover why certain cases are not making more favorable progess. The laboratory work is heavy. For example, 760 tests for complement fixation for tuberculosis, and the same number for syphilis were made. Throat cultures, blood analyses, sputum cultures for secondary organisms, cultures from boils and many other bacteriological examinations were made. Whenever the urine contains albumin, search is made for tubercle bacilli, and guinea pigs are inoculated. A rapid method of diagnosis of renal tuberculosis is now being studied. Chemical analyses are made of the stools of patients having symptoms suggesting intestinal toxemia, and dietary treatment instituted. After a study of many thousand cultures it has been possible to demonstrate several types of human tubercle bacilli. The influence of vitamins on the development of tuberculosis, and on experimental tuberculosis is in progress. Work on the serums of immunized sheep has disclosed antibodies to be present in the globulins. The X-ray work has steadily increased in volume and in importance. A new building is almost imperative because of the crowded condition of this department. The work of the nursing staff during the past year is highly commended. The class of twelve nurses has been kept full and their standard is good. The medical library is growing more valuable each year and has been reorganized.—*Annual Report of the Trudeau Sanatorium Medical Board, L. Brown, Annual Medical Report of the Trudeau Sanatorium, 1919, October 31, 1.*

Medical Report of the Trudeau Sanatorium.—The elimination of all nontuberculous cases from the sanatorium is still a difficult problem. The exclusion of hyperthyroidism by subcutaneous injections of adrenalin remains uncertain, whereas the subcutaneous tuberculin test is being employed with increasing advantage—failure to react to a second dose of 10 mgm. of tuberculin ruling out tuberculosis. During the past year an attempt has been made to classify all patients by physical signs and X-ray findings as the use of the former alone is often misleading. The following classification has therefore been adopted: 1. The incipient group X-ray showing a unilateral area involved only extending down to the second chondrosternal junction or a pleuritic shadow. 2. The moderately advanced group: here an entire lobe may be involved with cavitation not greater in extent than one intercostal space. 3. The far advanced group: here a shadow greater in extent than the area of one lobe is shown

with areas of rarefaction greater in extent than the area of one intercostal space. Statistics of cases treated are appended as well as a number ot reprints of articles by members of the staff.—*35th Medical Report of the Trudeau Sanatorium and the 15th Medical Supplement, 1919, F. H. Heise, 6.*

Epidemiology of Phthisis.—Gordon emphasizes the importance of the work of Brownlee and confirms the investigations made some years ago in Devonshire which proved that the prevalence of phthisis is promoted by strong rain-bearing winds. The following may now reasonably be regarded as established: 1. In Devon, people exposed to strong, rain-bearing winds, suffer considerably more from phthisis than people sheltered from them. 2. Throughout the world, wherever trustworthy statistics exist, the same influence of these winds is traceable. 3. These winds also adversely affect the course of the developed disease in patients exposed to them. This accounts for the frequent disappointing results of sanatorium treatment due to ill-chosen sites. Tuberculosis in cattle is influenced in the same way, yet this point has received no attention. 5. Altitude per se, exercises no appreciable effect, after the influence of rain-bearing winds has been eliminated. 6. Geological formation does influence the prevalence of phthisis. 7. The effect of occupation and density of population is modified by coexisting climatological conditions. 8. "The principle of the approximate isolation of influences" must be recognized and applied in order to place the subject of climatology on a solid scientific basis.—*The Epidemiology of Phthisis, W. Gordon, Brit. J. Tuberc., July 1920, xiv, 112.*

The Début of Tuberculosis.—Three infants were known to have been contaminated by the mother at a certain date. The period before they became capable of responding to the intracutaneous tuberculin test was shorter, the older they were and the greater the exposure. During this *période antéallergique* there are absolutely no clinical manifestations to attract attention to the infection. The minimum period seems to be six days, and the maximum, judging from this experience, is four months.—*La période antéallergique de la tuberculose; pénétration silencieuse du bacille tuberculeux dans l'organisme du nourrisson, R. Debre and P. Jacquet, Annal. d. Méd., 1920, vii, 122.*

Muscle Signs of Pulmonary Tuberculosis.—Halbron and his co-workers examined 157 patients and 52 healthy controls for the abrupt local contraction of the trapezius and other muscles when the margin was suddenly pinched. This has been cited as a sign of a chronic tuberculous process in the lung on that side. The contraction across the muscle feels like a cord, and Lévy even contends that the absence of this *corde musculaire* or myo-edema excludes tuberculosis, or at least an active process. The myotonic reaction in the trapezius occurs normally on both sides; it is significant only when it is exaggerated on one side. The reflexes on percussion of the deltoid, pectoralis and supraspinatus are more pronounced on the diseased side. These muscle signs were pronounced in from 81 to 96 per cent of the tuberculous examined, usually the active cases. The findings were positive only in 10 per cent of the presumably healthy controls. These muscle signs are especially useful in dubious cases, and in suggesting a tuberculous origin for emphysema and chronic bronchitis. The reaction does not always correspond to the side with the most extensive lesions, but to the most active. Sainton greases with petrolatum the thumb and forefinger for pinching the muscle, and states that the myo-edema never lasts for more than eight to twelve seconds. It occurs most pronounced and persistent in typhoid, in chronic pulmonary tuberculosis, and in lead poisoning, and is a sign of impregnation of the organism with toxins. Lion reported positive findings even with intoxication from stenosis of the pylorus.—*La valeur des phénomènes musculaires au cours de la tuberculose pulmonaire chronique, P. Halbron, L. Pradal, and B. Theodoresco, Bull. d. l. Soc. Méd. d. Hôp., November 21, 1919, xliii, 973.*

Localization of Pulmonary Lobes by the X-Ray.—By means of the X-ray chest plate thoracic lesions can be accurately located before operation. The lower right and left lobes are often difficult to accurately localize in the normal chest. On good stereoscopic plates taken with fuller exposure and softer tube than for chest examinations one notices that a greater number of branches are given off the main stem bronchus posteriorly, and if the trunks have been carefully charted in the upper lobes, the rest of the chest cavity is occupied by the lower lobes. The trunks, e.g., the heavy lines extending from the hilum into the lung fields, are the increased densities which are produced upon the X-ray plate by the bronchi and accompanying vessels. If the lung fields are divided into three zones, (1) hilum or root zone, (2) trunk or middle zone and (3) periphery or pleural zone, we will find that the heavy masses at the root are the hilum, and

the trunks extending out in all directions, and beyond them are many fine branches, the so called linear markings. The branches of the vertebral trunk are so close together on the plate that unless there is a lesion it is impossible to separate them. Physical signs of this area are heard in the supraclavicular or supraspinous fossa. Apex lesions are limited to the area within the circle of the first rib. If one thinks of the fifth rib as marking the upper border of the lower lobe, it will help him to visualize the lobes. To be accurate this rough line needs modification: (1) The incisura above the lower lobe at the chest wall is a little higher on the left. (2) The apices of the lower lobes extend slightly above the fifth rib near the spine. (3) The incisura reaches the diaphragm so that in front it extends below the fifth rib. But lobes are not constant. The lung is a very movable organ and contractile tissue frequently dislocates the normal position of the lobes. There are a few differences between the upper left and the upper right lobe. The hyparterial bronchus passes under the left pulmonary artery as well as under the arch of the aorta. The lingula tip has its own trunk and by some is compared to the middle right lobe. Diaphragmatic hernia can easily be diagnosed, the movement of the diaphragm be watched and the posterior mediastinum inspected.—*Localization of Pulmonary Lobes by the X-Ray, K. Dunham, Med. Rec., June 26, 1920, xcvii, 1077.*

Fluoroscopy vs. Physical Diagnostic Methods.—At Camp Lewis, Wash., of 16,589 soldiers who were sent up for fluoroscopic examination, 4563 were reëxamined and 570 were rejected on account of active tuberculosis, though according to roentgenologic examination 1843 were tuberculous and suspicious. In analyzing the official tabulated results of rejected cases it was found that of the 570 rejects on the clinical diagnosis made by the tuberculosis specialists, the roentgenologic examination detected 315 or 55 per cent positive tuberculosis. Of 343 cases reported by the fluoroscopist as unqualifiedly tuberculous, only 315 were rejected. Of the 1500 reported by the fluoroscopist as suspicious, 1372 were accepted by the tuberculosis specialists for full military service, while 128 were rejected with unmistakable physical findings of chronic active fibrocaseous tuberculosis. Of the 2349 reported by the fluoroscopist with an abnormality, 2249 were accepted on physical examination for full military service and 100 were rejected by the tuberculosis specialists for chronic active fibrocaseous tuberculosis. Of 12,393 reported negative by the fluoroscopist, 27 were found with physical findings sufficient to justify a diagnosis of chronic active fibrocaseous tuberculosis and were rejected. In a group of 216 cases of active pulmonary tuberculosis rejected, in which the specialists confirmed the diagnosis of the preliminary examiners, only 116 of them, or 54 per cent, were recognized as positive tuberculosis by means of the roentgenologic examination. These were all cases in which the preliminary examiners were able to make the diagnosis on physical findings alone. Of 83 cases sent to the X-ray laboratory with a diagnosis of inactive or healed tuberculosis by the preliminary examiners and confirmed by the specialists, only 47, or 56 per cent, were positively diagnosed under the roentgen ray. The above data clearly indicate the shortcomings of fluoroscopic examination in chest work which can never supersede physical examination. The author disputes the claim made by Matson that "the physical signs in the case of chronic fibrocaseous tuberculosis are minimal and susceptible of recognition only by the experienced clinician, but the screen findings offer unmistakable evidence of the abnormality in question."—*Fluoroscopy versus Physical Diagnostic Methods of Chest Examination in Army Work, D. C. Twichell, Southwest. Med., August, 1920, iv, 3.*

Body Weight.—The literature furnishes an embarrassing variety of standards by which to judge whether the weight of a given person is within normal limits. To enable the physician or statistician to choose between these methods, the authors collected measurements and actual weights on a series of 249 normal soldiers, then predicted the weights for these men by means of various standards, and finally by comparing these predicted weights with the actual weights, computed the error made by each standard. They arrived at the conclusion that the normal weight for an American man may be predicted somewhat more accurately by Bornhardt's formula than by the Army and Navy table, the Medico-Actuarial, Guthrie's, Broca's, or von Noorden's standard. This was true for a series of 249 native-born men, aged eighteen to thirty-four years inclusive. Whether it would also hold true for other men, for women and for children, cannot be stated. Bornhardt's standard was uniform in accuracy at varying ages, weights, heights and chest girths. Though other writers have urged the value of routinely recording the chest perimeter as well as height, nobody has incorporated it into a formula as simple as Bornhardt's. And just as his rule (based on height and chest girth) as a rough measure of surface

seems both theoretically and empirically the best guide so far offered for guessing weight, so we expect that experiment would discover an even better rule (based on height, chest and a third factor) expressing a rough measure of volume. For fundamentally weight must be proportional, not to length nor surface, but to cubic mass. In Bornhardt's formula, if H be the height without heels in centimeters, C the mean chest girth in centimeters as measured over the nipples, W the net weight in kilograms, then the expected weight for the adult of average constitution is $W = H \times C/240$.—*Body Weight in Two Hundred and Twenty-Nine Adults. Which Standard is the Best? H. Gray and J. F. Mayall, Arch. Int. Med., August, 1920, xxvi, 133.*

Chest Measurements.—It is futile to record chest measurements at the nipple line, for the following reasons: (1) Lung capacity and competency cannot be estimated by a tape line nor actual lung disease excluded. (2) The degree of chest expansion or mobility, expressed in inches on reports of physical examinations, are of no value except to suggest developmental possibilities in the immature. (3) The form of the chest in young men is immaterial, since all forms can be increased in size by rib elevation through muscular development. None of the classical chest forms are incompatible with great lung power and physical vigor. (4) If chest mobility is to be recorded by inches, the measurements should be made at the level of the ensiform cartilage. —*Insignificance of Recording Chest-Measurements Made at Nipple Line, R. M. Culler, Mil. Surgeon, June, 1920, xlvi, 646.*

Early Diagnosis.—In New Zealand hemoptysis, unless due to hydatid cyst, is always tuberculous in origin. So is pleurisy with effusion, although not every case subsequently develops phthisis. The general ill health and toxic symptoms are the same in New Zealand as noted everywhere; when such symptoms persist or recur from time to time without any obvious cause, a study of the temperature should be made. Temperature charts of early phthisis, as observed by the author, are quite distinctive—97° in the morning and 99.4° or so in the afternoon —and, with other causes excluded, are as positive an indication of phthisis as can be had without physical signs. Cough is always an accompaniment of active tuberculosis. The first physical signs are to be sought on the contiguous borders of the upper and lower lobes, close to the edges, and more frequently on the right side. X-ray examination should be a routine measure in all cases, especially for the differential diagnosis of lung cysts, which may exactly simulate phthisis. Also, a clear conception of the deficient expansion of the apex is best obtained by this means. The author has given up the use of tuberculin in diagnosis, as too dangerous.—*Early Diagnosis of Pulmonary Tuberculosis in New Zealand, A. Foster, Brit. M. J. May 29, 1920, 753.*

Differential Diagnosis.—Diagnostic difficulties are often encountered not only in the early cases, but also in those of long standing with many chest signs. The history of five of the many cases treated at Gouverneur Tuberculosis Clinic during the past ten years are given. The following has been deduced from these cases: (1) Do not make a diagnosis on one examination. (2) Bear in mind the possibility of tuberculosis coexisting in an apparently uncomplicated case of chronic bronchitis with emphysema. (3) Do not neglect to make a Wassermann and search for other signs of syphilis. (4) Even if the X-ray does not show the presence of a foreign body, the latter may be the cause of a chronic lung suppuration. Experience shows that a careful weighing of all the elements presented, plus time, is necessary in order to arrive at a correct diagnosis. —*Chronic Pulmonary Conditions Simulating Advanced Tuberculosis, W. Narins, Med. Rec., June 12, 1920, xcvii, 997.*

Physical Findings in Pneumothorax Lungs.—From the very large material of the Sanatorium Schatzalp-Davos, the author selected typical cases which could be followed up until practically recovered and sums up his observations on the condition of the compressed lungs as follows: In course of time the pneumothorax lung tends to reëxpand. The physical signs show a certain uniformity: retraction and lagging of the pneumothorax side with diminished motion of the diaphragm and lower lung border, diminished pulmonary resonance or dulness, diminished vocal fremitus, increased or bronchovesicular breathing, and loud, dry râles. There is either no sputum or only small quantities without tubercle bacilli. The sound side is enlarged. Exudate cases show thickened pleura, as evidenced by diminished motility, breath sounds, voice and fremitus. After thoracoplastic operations the findings are proportionate to the extent of the collapse obtained. The lung can never assume normal conditions. Auscultation and percussion findings are similar to those in extensive shrinkage of the lung, namely, marked dulness and tympany, absent or diminished breathing, generally of a bronchial character, persistent and abun-

dant coarse râles, disfigurement of the chest skeleton and atrophy of the soft parts. Sputum is either absent or without tubercle bacilli. The other lung is much enlarged.—*Ergebnisse der physikalischen Untersuchung bei der Kollapslunge nach Pneumothorax und Thorakoplastik, C. Real, Beitr. z. Klin. d. Tuberk., 1915, xxxv.*

The Diagnosis of Malignant New Growths of the Lungs and Pleura. Sokolowski describes twenty cases. Some of these show symptoms similar to those which are present in chronic pulmonary tuberculosis. X-ray examination and bronchoscopy greatly aid the diagnosis. A microscopic examination of the sputum should also be made, although it is rare to find characteristic cells of new growth in the heavily bloody sputum. The X-ray shows sharply circumscribed shadows in cases of more or less circumscribed infiltrated pulmonary and pleural new growths located towards the surface and in the lower and middle lobes. It is of great value in the differentiation between apical tuberculosis and new growths. The shadow of a neoplasm generally does not cover the point of the apex, and the latter is visible around the shadow in the form of a light stripe. The absence of disseminated foci is characteristic in neoplastic apices. In new growth of the lower lung and pleura accompanied by pleural exudate, as so often occurs even in the early stages, the extensive shadow only reveals exudate, and the total clinical picture must determine the diagnosis, especially the cachectic appearance of the patient. Fluoroscopy only exceptionally reveals the tumor, and then the exudate must be small and of a purely serous character. This is still more true of new growths developing centrally from a bronchus. Bronchoscopy is of great value in these latter cases. Through the bronchoscope it is often possible to discover an incipient new growth, and by removing a piece for microscopic examination to determine its nature and histologic details. In cases with symptoms of stenosis, bronchoscopy may reveal even at an early stage that the dyspnoea is caused by pressure on a bronchus, and it may even reveal the depth of the disease. Sokolowski draws the following conclusions from his twenty cases: (1) Sixteen of the cases started from a bronchus and gradually invaded the lung-tissue in the form of smaller or larger infiltrations. In ten of these the neoplasm was in the left lung, in seven in the upper and in three in the lower lobe. One case had stenotic signs for two years, after which the tumor spread over the whole left lung. Three had signs of exudate. Only two of the twenty cases were women. The duration of the illness was from a few months to four years, the average being about one year. (2) Chest pain must be particularly noted among the subjective symptoms. It was generally unilateral. With six patients this was a permanent symptom, with one patient a permanent and dominating one, and was localized in the affected side from the beginning of the disease to death. Other symptoms are cough, difficulty of breathing, and dyspnoea on the slightest exertion. With all patients gradually increasing cough and dyspnoea were present until death. Purulent and bloody sputum appeared most often in the later stages, and copious blood spitting quite often in the last stages. The bloody, raspberry-jelly-like sputum reminds one of that occurring in lung infarct. Exceptionally there occurs steady but slight blood-spitting for a long period of time, suggesting strongly tuberculosis. (3) One of the most constant subjective symptoms is gradual emaciation and loss of strength. This is often the primary symptom. There are exceptional patients, with quite a well developed process, who look well, and who claim that they feel well. With these patients the focus is bronchial. (4) The statement usually made that pleural or pulmonary neoplasms cause no fever is incorrect. There is either permanent or intermittent fever of varying character or intensity. Constant fever most often occurs when the growth begins to break down, that is in the later stages. (5) Physical signs: The affected side may be distended or retracted. On the skin of one or both sides of the chest dilated subcutaneous veins are sometimes prominent. In the subclavicular region groups of indurated lymph nodes are occasionally observed. In foci developing centrally no percussion changes are observable for a long time. Superficial neoplastic infiltrations reveal a very typical and irregular dulness confined to one part of the lobe. In the last stages, especially in the presence of pleural exudate, there is dulness over the entire posterior and anterior half of the chest. On auscultation there are no typical physical signs. Malignant neoplasm should be suspected when in the presence of chest symptoms considerable loss of weight and strength occurs and other conditions can be excluded.—*Zur Diagnose der bösartigen Neubildungen der Lunge und Pleura, A. Sokolowski, Beitr. z. Klinik d. Tuberk, May 10, 1916, xxxv, 205.*

Tuberculin Tests in an Isolated Parish.—The parish—F. valley—Norway, with a total population of 60, is well isolated and has its own school. It is seldom that one

of its members comes in contact with the outside world. Not a school child was infected. Twenty-one or 40 per cent of the 53 examined showed a positive reaction and 32 or 60 per cent showed a negative reaction. No one below the age of sixteen was infected. Ten out of 17 children had enlarged glands in the neck. Seven out of these 10 had bad teeth. The enlarged glands are attributed to the bad teeth. On the whole the entire population had bad teeth and the care of the teeth was practically unknown. In this parish no death has been known to have occurred from tuberculosis.—*Von Pirquet Investigations in a Parish Without a Notified Death from Tuberculosis, E. Bjorn-Hansen, Tubercle, May, 1920, i, 359.*

Skin Sensitivity to Tuberculin Test.—The multiple papillary cutaneous test of Ellis is regarded by Luker as a reliable, time saving, tentative method of preliminary sifting of cases into such classes as: (a) Clinically active, (b) doubtful, (c) quiescent, (d) nontuberculous. Though the test results of these carefully determined minimal effective doses furnish no reliable data as to the amount of lung involvement, yet they give some criteria as to the toxemia present. The test is a valuable guide in estimating the threshold of probable reactions to Koch's hypodermic test or the optimum commencing dose in tuberculin treatment. In the routine examination of individuals presenting no obvious defects, an intracutaneous injection of 0.0001 cc. O. T. compared with a similar control of physiologic sodium chloride solution would serve as a quick, reliable way of differentiating candidates into clinically affected and doubtful classes.—*Skin Sensitivity to Koch's Old Tuberculin under Dispensary Conditions, D. Luker, M. J. Austral., June 12, 1920, i, 548.*

The Subcutaneous Tuberculin Test in Adults.—Fifty-five doubtful cases were tested under the necessary precautions with doses of 0.1, 0.5, 1.0 and 5 mgm. O. T., injected subcutaneously twice a week. Seven reacted negatively, 12 showed a focal and 36 a general reaction. Focal reactions occurred once after 0.1 and once after 0.5 mgm., and 4 times after 1 and 6 times after 5 mgm. General reactions occurred twice after 0.1, 7 times after 0.5, 14 times after 1, and 13 times after 5 mgm. The author comes to the conclusion that the subcutaneous test should be abandoned because it has so very little diagnostic value and because it may do harm.—*Was leistet die subkutane Alttuberkulinprobe zur Erkennung der aktiven Lungentuberkulose bei Erwachsenen? Bochalli, Beitr. z. Klin. d. Tuberk., 1915, xxxv.*

Seasonal Fluctuation of Susceptibility to Tuberculin.—For several years the author had noted that at times tuberculous children showed very acute reactions to small doses of tuberculin but he was inclined to attribute them to an error in dosage. On careful study of the matter, however, it appeared that small intracutaneous doses might produce not only local but even general reactions at times. Taking note of the time of year he found that in the fall children with outspoken tuberculosis gave positive reactions only with relatively large doses of tuberculin and further that cases with signs of a healed lesion gave only delayed reactions to a dose of 1 mgm. He therefore concluded that the tuberculin susceptibility is ordinarily greater in the spring than in the fall and correlates this observation with the fact that the frequency of tuberculosis is greater in the spring than in the fall. Tuberculin susceptibility is a function of immunity and the degree of the reaction is an indication of the activity of the protective mechanism of the body, extreme reactions signifying a most energetic defense against the progress of the disease. Underlying the seasonal variation in the incidence of tuberculosis is the fact that in winter children are confined within doors and as a result they most often appear with disease in the spring after their resistance has been reduced.—*Jahreszeitliche Schwankungen der Tuberkulinempfindlichkeit, F. Hamburger, Münch. med. Wchnschr., April, 1920, lxvii, 398.*

Prognostic Value of the Cutaneous Reaction to Old Tuberculin and to Partial Antigens.—After a review of the literature the author deduces the following fundamental principles upon which he bases his theory of the skin reaction in a tuberculous individual: (1) The cutaneous tuberculin reaction is strong because many antibodies are present and therefore, by combination with the antigen anaphylotoxin is split off. (2) The cutaneous tuberculin reaction is weak or absent; (a) because too few antibodies are present allowing the absorption of much of the antigen; (b) because so much antibody is present that the antigen is quickly reduced to a nontoxic end product; (c) because of the absence of tuberculosis and a consequent absence of antibodies; (d) because of nonspecific influences. In an attempt to obtain information of value in prognosis Kämmerer used old tuberculin intracutaneously in dilutions of 1:100, 1:1,000 and 1:10,000. Careful note was made of the extent of the infiltration, the extent and intensity of the erythema, the occurrence of vesicles, pustules, necrosis, nodulation,

lymphangitis and lymphadenitis. The clinical material consisted of a large number of cases which were either definitely nontuberculous, suspects, or undoubtedly tuberculous in various degrees of severity. Readings of the skin reactions were made daily but most frequently on the fourth, fifth and sixth days. Only the strong reactions are of value in determining a prognosis; for those of a moderate grade occur in fully fifty per cent of all the cases. The failure led to a repetition of the test using Much's partial antigens, both the M. Tb. R. (the lactic acid residue of tubercle bacilli), and the single antigens, A, the albumin, F, the fatty acid lipoids, and N, the neutral fats. The M. Tb. R. was used in three dilutions, 1:10,000,000, 1:100,000,000 and 1:1,000,000,000. The reactions on cases of all types were weak and confusing. Seventy-eight patients were then given simultaneous intracutaneous injections of A., F., and N. in the following strengths, A., 1:10,000,000; F., 1:10,000; and N., 1:1,000. Most of the cases were clinical pulmonary tuberculosis in various stages while a few were nontuberculous. No clean cut evidence of value in prognosis was obtained. The author states that on the whole he thinks the partial antigens are less serviceable than old tuberculin for purposes of prognosis. He then considers briefly the work done by various investigators on the effect of nonspecific influences on the cutaneous reaction, e.g., by the administration of potassium iodide, thyroid extract, benzol, typhoid inoculations, intercurrent acute infections, old age, and malnutrition. He shows that when the body is vigorously engaged in the desaturation of antigen the cutaneous reaction becomes weakened not only to the specific antigen used but to others as well. Because of the frequency of nonspecific influences which affected the reaction he was led to seek a solution of the problem in the so called sensitizing reaction with O. T. This consists in the injection of a given dose of old tuberculin and repeating the dose in eight days, perhaps in the opposite arm. The second reaction is very much more severe than the first and as the result of the sensitizing action of the first dose, a condition analogous to anaphylaxis arises following the second injection. This is due to a mobilization of antibodies from the focus through the circulation to the skin rather than a sudden new formation of antibodies. One hundred and three cases were given primary injections of old tuberculin in three dilutions (1:100, 1:1,000, and 1:10,000), each 0.2 cc. in the right arm. Controls were made daily for five to six days. On the eighth day the same doses were repeated in the left arm. Sixty-six of the cases showed an increased reaction to the second dose, while 37 were of the same strength or decreased. The striking feature, however, was that 52 of the 66 cases with increased reaction showed a very rapid development with an equally rapid subsidence of the local signs. This is again proof of the anaphylactic nature of the reaction, and may be explained as a rapid and complete destruction of the protein molecule. These results justify the conclusion that in cases having a favorable prognosis the second reaction will be increased while the unfavorable case will show a second reaction either the same as the first or less in degree. The healthy individual or one with only slight disease reacts definitely and strongly to the second injection because the sensitizing dose either mobilizes antibodies or new ones are formed. The sensitizing reaction was likewise repeated using Much's partial antigens in the same manner, but it was difficult to differentiate between mild and severe types of cases. Likewise old tuberculin and partial antigens were used in combination but without any particularly striking results.—*Was bedeuten die kutanen Reaktionen mit Alttuberkulin und Partialantigenen für die Prognose der Tuberkulose?, D. Kämmerer, Münch. med. Wchnschr., March 26, 1920, lxvii, 375.*

Pirquet Reaction in Pulmonary Tuberculosis.—The object of these investigations was to estimate the value of the cutaneous tuberculin test as a diagnostic and prognostic agent in cases of pulmonary tuberculosis. Of 100 cases tested the following conclusions were arrived at: In adults, the von Pirquet test is of little value as a diagnostic and prognostic agent, except in a very limited number of cases. 2. A negative reaction is no proof that a patient is nontuberculous. 3. A negative reaction may be obtained in advanced cases, and a markedly positive reaction does not necessarily indicate a good prognosis. 4. The reaction is always positive when tubercle bacilli are present in the sputum, except in advanced cases. 5. In children the reaction may be negative in 30 per cent of cases of pulmonary tuberculosis. 6. After sanatorium treatment the percentage may be reduced to 17, the reduction indicating an improvement in the immediate prognosis.—*The von Pirquet Reaction in Pulmonary Tuberculosis with Notes of a Few Cases, W. A. Muir, Brit. J. Tuberc., July 1920, xiv, 115.*

Tuberculin in Animals.—The following conditions are often the cause of disappointment in applying the tuberculin test: 1.

The tuberculin has not been properly prepared. 2. The records of post-injection temperatures do not extend over the required length of time to detect late reactions. 3. Infected animals are tested during the period of incubation before lesions have developed 4. The lesions are arrested, encapsulated, healed or very extensive. 5. Animals should be considered as unfit to receive the test when in advanced pregnancy or when passing through the period of estrum. 6. Animals suffering from any acute infectious disease should be considered unfavorable subjects. 7. The quantity injected is insufficient. 8. Animals to be tested should be in a comfortable place, under normal surroundings, and allowed to remain quiet, especially when the reaction falls due, as some individuals under sufficient excitement will show a decided rise in temperature. 9. One should not fail to note clinical evidence of advanced tuberculosis, for extensive broken down lesions, setting free enormous quantities of toxins, may fail to cause a reaction with the usual amount of tuberculin injected. The author has given as much as ten times the usual dose in such cases with positive results. The tuberculin test is not a mere mechanical procedure but one which requires a reasonable amount of good judgment in its interpretation.—*Tuberculin, Its Reaction and Use, C. W. Gates, Amer. J. Vet. Med., August, 1920, xv, 366.*

Muscular Changes in Pulmonary Tuberculosis.—In the early stages of pulmonary tuberculosis as shown by the research work of C non, Minor, Crile, Fischer, and Pottenger, there is observed a tightening and increased tonus in such muscles as the trapezius, pectoralis major, sternomastoid and scaleni and a diminished movement of the diaphragm. In the later stages a degeneration and thinning of these same structures and the subcutaneous tissues overlying them had been noted. These changes are due to reflex action. The endings of the sympathetics in the pulmonary tissue are irritated by tuberculo-toxins and this irritation is transmitted chiefly through the third and fourth cervical segments to the muscles supplied by them. Besides motor, we have sensory disturbances, as pain in the shoulder and under the clavicle common in early tuberculosis and often mistaken for rheumatism or neuritis. These changes take place during any intrapulmonary inflammatory condition irrespective of the cause. The response is comparable to the marked spasm of the abdominal muscles seen in appendicitis. Increased spasm of the muscle manifests itself by a feeling of tenseness to the touch, increased convexity and a bunching up of the muscle fibres. When the condition becomes chronic the muscles degenerate and become atrophic. On palpation they assume a boggy, inelastic, stringy feel. Likewise, the subcutaneous tissue becomes thinner and loses its elasticity. Trophic changes are often manifested by pigmentation in the skin. Where muscles atrophy from disuse or emaciation, the subcutaneous tissue is not affected—a useful point in differential diagnosis. In children, Pottenger draws attention to the degeneration of the skin and subcutaneous tissues in the interscapular region from the second to the fifth dorsal spines, which he uses as a valuable diagnostic sign indicating marked bronchial gland involvement. This, combined with dulness on percussion, constitutes strong corroborative evidence. Increased tonus of the muscles around the shoulder girdle with pain, after eliminating occupational influences, is evidence of the presence of some acute intrapulmonary inflammatory condition, tuberculous or otherwise. If there is a definite degeneration of the muscles, subcutaneous tissue and skin, we may conclude that some chronic inflammatory condition of the lung or lungs is present, most likely tuberculosis. If there is an increased tonus of the degenerated muscles, this almost certainly indicates a renewed activity of the disease in an old quiescent focus. Galecki found increased spasm of the neck and chest muscles in 93 per cent of cases examined in early active tuberculosis. Percussion over degenerated muscle and subcutaneous tissue will lower the pitch of the note considerably and may often mislead one when comparing it with the healthy side which may be of the same pitch. The recognition and proper interpretation of these reflex signs will prove extremely helpful in diagnosis and will prevent mistakes. These changes are not apparent until looked for carefully and should not be attributed to mere general emaciation.—*On Muscular Changes Occurring in Pulmonary Tuberculosis, J. Craig-MacGown, Brit. J. Tuberc., July, 1920, xiv, 112.*

Intrapleural Tension.—Most of the physical and functional signs of an effusion in the pleura and several of the mishaps for which thoracocentesis is held responsible are in reality due to modifications of the intrapleural tension. By doing thoracocentesis without attempting to aspirate the effusion, the pressure rights itself and there is no danger of mishaps, and the patient does not become fatigued. He reclines on his back, the edge of the thorax close to the edge of the bed. The puncture is made in

the sixth or seventh interspace, as closeas possible to the posterior axillary line, and all of the fluid is allowed to escape spontaneously. The tension at the close was always found normal.—*Les tensions intra-pleurales dans les épanchements liquides de la plèvre. La thoracocenthèse sans aspiration et en position couchée, H. Flurin and J. Rousseau, Ann. d. Méd., 1920, vii, 325.*

Chromogenic Reactions in the Urine of Tuberculosis Patients.—The study was based on three different reactions, namely, the diazo reaction, the Moritz-Weiss urochromogen reaction, and the iodin reaction of Petzetakis. They have no diagnostic value, but their prognostic value is proved. The order of their importance is, first the urochromogen, second the diazo, and last the iodin test. The reactions result from the absorption of putrid substances by the circulation. Their presence indicates caseation and destruction of tissue. They appear together with positive intracutaneous tuberculin reactions.—*Reacciones Cromogenas en la Orina de los Tuberculosos, T. Seix, Arch. Espanol. de Tisiolog., May, 1920, i, 301.*

The Temperature in Pulmonary Tuberculosis.—There can be no activity of tuberculosis without a rise in temperature. Therefore, it is advisable to record the temperature every two or four hours. The temperature may stay normal for days or weeks or months and then jump. The longer the period of quiescence, the less likely is it to be interrupted and the more certain is healing by fibrosis. The taking of the temperature may seem a very easy thing, but it is exposed to many errors. The best way to take it is by rectum. Exercise causes a rise in the bodily temperature. The greater the difference between the evening and morning temperature the worse the prognosis is likely to be. Patients with a slight morning and evening rise should be put to bed and watched carefully.—*The Temperature in Pulmonary Tuberculosis, J. Watt, J. State Med., June, 1920, xxviii, 161.*

Complement Fixation Reaction in Tuberculosis.—Of the 6,500 reactions studied 2,078 were clearly negative and 1,027 were inconclusive (over 50 per cent hemolysis). There were 1,344 moderately positive (from 25 to 50 per cent hemolysis) reactions, and 2,051 strongly positive (no hemolysis) reactions. Of 1,103 sera from patients definitely proved to be tuberculous, 86 , or 78 per cent, gave positive reactions. The 238 negative sera in this group represent twenty-six moderately active, seventy-three arrested, and eighty acute or general tuberculosis, with no detailed information regarding fifty-nine sera. Of 521 sera from patients with clinical tuberculosis not confirmed by sputum or roentgen-ray examination, 336, or 64.6 per cent, gave positive reactions. Of 822 sera from patients in whom tuberculosis was suspected but not established, 303, or 37 per cent, gave positive reactions. Of 554 sera from patients who were not examined for tuberculosis, 183, or 33 per cent gave positive reactions. Of 168 sera from patients in whom examination revealed no evi ence of tuberculosis, seven, or 4.2 per cent gave positive reactions.—*The Complement Fixation Reaction in Tuberculosis: Reporting Six Thousand Five Hundred Reactions, W. W. Watkins and C. N. Boynton, J. Am. M. Ass., October 2, 1920, lxxv, 933.*

The Leucocytic Formula in Tuberculosis.—From a review of literature and personal work the conclusion is reached that there is in the mild forms of tuberculosis a leucocyte formula indicating resistance, characterized by normal total count, eosinophilia, lymphocytosis and changes in the Arneth count to the right. The prognosis in such cases is good. In tuberculosis of higher virulence there is a leucocytic formula indicating defense, with an increased total count, polynucleosis, normal or slight lymphocytosis and hypoëosinophilia, and changes in the Arneth count to the left. The prognosis is poor.—*La Formula Leucocitaria de la Tuberculosis, F. Jimenez Asua, Arch. Espanol. de Tisiolog., May, 1920, i, 167.*

Traumatic Pulmonary Tuberculosis.—There is as yet no uniformity of opinion on the subject of the relationship of tuberculosis of the lungs and trauma. The study of gunshot wounds of the chest offers a good field for this investigation. Four questions arise for discussion: 1. How many of those wounded in the chest were actually suffering from tuberculosis of the lungs at the time of injury? In many of these the acute condition made it impossible to employ physical examination to advantage. The X-ray revealed nodules of tuberculous deposit much more frequently. Six men out of 139 had positive signs of old tuberculosis of the lungs. 2. What is the after history of these cases? Four out of the six are at their old employment. One is still in the hospital and another in a sanatorium. 3. What proportion of cases with chest wounds develop pulmonary tuberculosis at a later date? The number of such cases is exceedingly small. It is not advisable to rely on physical examination. A careful scrutiny of the sputum for tubercle bacilli and a

thorough X-ray of the chest for the presence of a foreign body should accompany every examination. 4. What are the factors which influence the onset of the disease after trauma? Sergent says that the confined atmosphere, the insomnia resulting from pain and the prolonged suppuration had more to do with the incidence of phthisis than the original trauma. Our duty to the wounded men is not over when the temperature is normal. The septic chest is just as much in need of rest and exercise as the tuberculous chest. Breathing exercises safeguard against collapse of the lung, especially where the chest has been repeatedly aspirated.—*Traumatic Pulmonary Tuberculosis, J. B. McDougall, Tubercle, May, 1920, 1, 324.*

Infection and Predisposition in Tuberculosis.—By scrofulous diathesis and lymphatic temperament older writers meant a special state of the body or of the constitution which rendered an individual specially liable to local affections, such as scrofulous glands, white swellings, cold abscesses, lupus, etc. This constitutional state was supposed to be generally hereditary. The demonstration by Koch of a causal relation between the tubercle bacillus and scrofulous lesions does not prove that certain constitutional states have no predisposing influence upon tuberculous infection. Predisposing factors may be extrinsic or intrinsic, the former applying to those whose surroundings, occupation or mode of life expose them more frequently than other people to infection; the latter, to a lowering of resistance by deteriorating influences such as injuries, inhalation of dust, intoxication, disease, starvation, fatigue or some inherited defects. Evidence of latent or occult tuberculous infection of the cervical, mediastinal, bronchial and mesenteric glands was found in a large proportion of cases. Postmortem examination of 40 children under four years of age, in whom no clinical evidence of tuberculosis had been discovered, showed definite pathological evidence in 8. While according to Laennec, a supposition of heredity was permitted when the repetition of a number of cases occurred in the same family, Villemin showed that it should not be accepted as evidence without making reserves in favor of cohabitation and of other circumstances favoring the transmission of tuberculosis by contact. *It is better to attach too little than too much importance to the determining influence of predisposition.* We can hope to control tuberculosis permanently only if we take *comprehensive and thorough measures against infection*, but in doing so we must keep in mind that there are predisposing circumstances which call for special measures.—*Infection and Predisposition in Tuberculosis: A Summary of Some of the Views Held During the Last 100 Years, S. Delépine, Brit. J. Tuberc., April, 1920, xiv, 60.*

Influenza and Tuberculosis.—The records of the Ohio State Sanatorium show that epidemic influenza has had a decided etiologic relation to tuberculosis. Forty per cent of 615 tuberculous patients, admitted to the sanatorium since 1919, attributed their active tuberculosis symptoms to influenza. Of the 249 patients, 67 per cent had a negative tuberculous history prior to the epidemic of October-December, 1918, as far as could be determined, while in 33 per cent (or 13 per cent of total admissions) classified as reactivated, a definite or suspicious history of a previous tuberculosis could be elicited. Sixty-two per cent of the entire group had positive tuberculous sputum. A feature of the activated case was that 40 per cent had a nonsymptomatic period averaging five months following influenza, during which, in many instances, the patient returned to work. The tendency in these cases was toward a delay in diagnosis by ascribing the tuberculous symptoms to bronchitic sequelæ of influenza and therefore supposedly benign and temporary. These statistics are also quite uniform for the Missouri State Sanatorium and the North Carolina State Sanatorium. The Ohio State Sanatorium, with a patient population of 185 was entirely free from influenza during both epidemics. During the 1918 epidemic no regulations were in effect. It is, perhaps, reasonable to suppose that these open cases have a considerable immunity to the associated organisms of influenza: it is also just as reasonable to presume that the open-air-hygienic regimen was a considerable factor in their protection.—*Pulmonary Tuberculosis as a Sequel of Influenza, S. A. Douglass and W. P. Brown, Ohio State M. J., July 1, 1920, xvi, 506*

Influenza in the Tuberculous.—Summary: (1) In an outbreak of influenza in the tuberculosis pavilion of the Montefiore Hospital during January and February, 1920, 28 out of 127 patients were affected. The proportion seems to be about the same as might be expected among nontuberculous individuals. (2) The clinical form of tuberculosis and the stage of the disease had no influence on the liability of the patients to contract influenza. (3) Of the 28 patients who contracted influenza 9 died, which is a higher ratio of mortality than is generally observed; and 22 developed bronchopneumonia, again

a rate much higher than is usually seen. (4) It seems that the liability to complicating bronchopneumonia varies with the epidemic. During the epidemic of 1918 a smaller proportion of the patients developed this complication and the mortality was lower. (5) The clinical course of the influenza resembled that seen in the nontuberculous. The liability to develop complicating bronchopneumonia bears no relation to the stage, clinical form or acuteness of the tuberculous process in the lung and pleura. (6) In nearly all of the patients who recovered the complicating disease had no appreciable influence on the tuberculous lung lesion so far as could be ascertained by physical exploration of the chest or on the subsequent course of the disease. (7) We cannot say that the anergic state brought about by influenza has had an influence on the incidence, course and termination of this disease in the tuberculous.—*Influenza in the Tuberculous, M. Fishberg and E. P. Boas, Am. J. M. Sci., August, 1920, clx, 214.*

Tuberculosis of the Eye in the Army.—Eight cases of tuberculosis of the eye found at Camp Travis are reported in detail. The occurrence of eye tuberculosis in men who have passed several physical examinations before being accepted for army service is to be explained by the fact that they were arrested cases in whom a focus became active under the increased physical and mental strain of the intensive training. The limited number of cases seen include new lesions and new lesions engrafted on old ones. Tuberculin was used for both diagnostic and therapeutic purposes. The men were returned to duty within a short time after the acute stage had passed, as it seemed inadvisable to keep them in the hospital idle and apparently in good health, in order to receive one tuberculin injection a week. Relapses are possible and should be carefully looked for; tuberculin treatment should be continued in civil life.—*Tuberculosis of the Eye in the Army, H. H. Stark, Am. J. Ophth., April, 1920, iii, 262.*

Importance of Tuberculous Laryngitis.—A more active interest in tuberculosis should be taken by laryngologists. There should be more thorough and uniform teaching of the diagnosis of this disease, and it should be carried on in such a way that the student will have opportunity to examine large numbers of incipient cases, and to see these repeatedly, and thus familiarize himself with the laryngeal image seen in tuberculosis as compared with that found in other allied conditions. Mullin suggests that a committee of laryngologists representing the various laryngologic societies may be formed to meet with a committee from the National Tuberculosis Association for the purpose of standardizing the literature and teaching of this subject, and with the further object of stimulating clinical investigations and pathologic research concerning this condition.—*Indifference of the Laryngologist Toward Tuberculous Laryngitis and the Tuberculosis Problem, W. V. Mullin, J. Am. M. Ass., July 31, 1920, lxxv, 300.*

Tuberculosis of the Thyroid.—The literature on the subject may be divided into three classes: (1) Reports of isolated cases usually of the so called primary type, in a number of which the clinical picture and pathological appearance of the gland had been modified by secondary infection and abscess formation. (2) Descriptions of the histological findings in thyroids obtained in routine necropsies of persons who had died of general miliary tuberculosis. (3) Studies based on reviews of the pathology of simple and exophthalmic goitres. Mosiman's report brought out the striking relationship between hyperthyroidism and tuberculosis of the thyroid. This association is evidently not a coincidence; either a hypertrophic thyroid is rendered more susceptible to invasion by the tubercle bacillus or the infection stimulates the parenchyma to an abnormal activity and is thus indirectly responsible for the hyperthyroidism with its attendant symptoms. Although the great majority of hypertrophied thyroids are not tuberculous, any infection which may even in a few instances be an etiological factor is of interest in dealing with a disease, the cause of which is so shrouded in mystery. Few, if any, of the cases of tuberculosis of the thyroid which have been reported were diagnosed previous to the microscopic examination of the glands. Seven cases are briefly reported from the Mayo Clinic. The condition was not suspected in any of them previous to operation. They are divided into three groups: (1) Cases with high degree of hyperthyroidism. (2) Those with moderate degree of hyperthyroidism. (3) Those in which hyperthyroidism was mild or absent. The greater the tuberculous involvement, the less severe the toxic symptoms. All cases of tuberculosis of the thyroid are secondary to some focus elsewhere in the body, although none were discovered in the 7 patients.—*Tuberculosis of the Thyroid, W. A. Plummer & A. C. Broders, Minn. Med., June, 1920, iii, 279.*

Tuberculosis of Pulmonary Lymph Nodes in Infancy.—In this form of tuberculosis the human type of tubercle bacillus

is almost always the cause, the bovine type being seldom found. Heredity is of no importance in the etiology and no specific diathesis can be made out. The pathways of infection, in order of their importan e are the respiratory tract, the digestive tract, the nasopharynx and the skin. The blood stream is only a means of transportation. The disease presents itself first in the cervical and then in the tracheobronchial lymphnodes and from there invades the lung tissue. Symptoms are divided into three groups: general, local and localized at a distance. The X-ray and clinical laboratories are a great help in the diagnosis. The prognosis is most grave in breast infants. It is influenced by environment, intercurrent diseases and complications. The treatment is based on the familiar hygienic-dietetic-rest schedule. Tuberculin is of great value. Best results are obtained under sanatorium regimen.—*Tuberculosis Gangliopulmonar en la Infancia, J. Garcia del Diestro, Arch. Espanol. de 1 isiolog., May, 1920, i, 257.*

Tuberculous Meningitis with Recovery.—Although tuberculous meningitis is generally fatal, a few cases are on record which show that recovery is possible. A woman, aged thirty-seven, had a tuberculous kidney removed twelve years previously, but had been well since. The first symptoms of meningitis were pains in the limbs and intense headache. On admission to the hospital the head was somewhat retracted, neck and legs stiff, Kernig's sign present, and reflexes normal. Lumbar puncture, performed about three weeks later, showed a clear fluid under pressure, containing tubercle bacilli. For thirteen weeks, the general condition varied between de irium and coma, with signs of distress and headache. The temperature was of an irregular intermittent or remittent type, reaching 102° to 103° in the evening. The pulse was irregular. In the fourteenth week, the temperature dropped, and a slow convalescence began. By the nineteenth week, the patient was taking full nourishment; and in the twenty-eighth week she was disch rged perfectly well in every way. Lumbar puncture was first performed in the fourth week, and was repeated in the fifth, sixth, and eighth weeks. The first punctures relieved the symptoms of intracranial pressure, but the last gave no relief, and the case was regarded as hopeless. It is very probable that recovery was aided by the earlier puncture.—*A Case of Tuberculous Meningitis with Complete Recovery, H. Barber, Brit. M. J., May 1, 1920, 601.*

Is Tuberculous Meningitis Curable?—Harbitz cites evidence from the literature that tuberculous meningi is can pass into a phase of fibrous transformation which results in the complete cure of the active disease. Rössle has reported a case of chronic tuberculous meningitis in a woman of thirty-seven with final fatal coma after seventeen months, and Harbitz here describes a similar chronic case with a five and possibly eight months course in a man of thirty-eight with necropsy findings showing mild tuberculous meningitis just entering a phase of anatomic healing. Another feature of the case was the spreading of the infectious process along the blood vessels into the brain and spin l cord, thus presenting the picture of diffuse tuberculous encephalitis and myelitis. In 60 per cent of cases of tuberculous meningitis, the patients are infants, and in them it is invariably fatal. The instances of a chronic course and recovery are nearly all in adults, the resisting powers or increased immunity aiding in the struggle against the infection. Epidemic cerebrospinal meningitis often entails hydrocephalus and changes in the brain, with mental disturbance. But tuberculous meningitis seems to escape this tendency. If the patient recovers he is not left with defects. Lumbar puncture and tuberculin treatment may contribute to the favorable outcome. In conclusion Harbitz cites a case from Overland's practice in which a girl of about seven had long presented symptoms of tuberculous meningitis, but finally recovered and in time married and has borne two children.—*Kan en tuberkulos meningit vaere en helbredelig sygdom? F. Harbitz, Norsk Mag. f. Laegevid, July, 1920, lxxxi, 644.*

Bovine Infection in Tuberculous Meningitis.—Forty-eight strains of tubercle bacilli were isolated from the cerebrospinal fluid of 48 cases of tuberculous meningitis. For primary cultivation of all the strains, Dorset's medium with and without the addition of glycerine was used; for secondary cultures, glycerine egg. Human strains gave a luxuriant growth on glycerine egg, while the bovine strains grew best on plain egg. While a dry growth is characteristic of human strains, and a moist growth of bovine, this is not alone sufficient to distinguish between the two. Rabbit virulence tests of moist strains are necessary to confirm their bovine character. Of the 48 strains tested, 3 proved to be of the bovine type.—*Incidence of Bovine Infection in Tuberculous Meningitis, N. Novice, J. Med. Res., January, 1920, xii, 239.*

Tuberculosis of the Breast.—One case of tuberculosis of the breast is reported in a woman of forty-four, with a history of pulmonary tuberculosis, but no symptoms for five years. The breast lesion was a small tumor which developed after a bruise; there was one small gland in the axilla, but without tenderness. A radical operation was done. The breast showed a caseous area in its centre, as did also the gland. No tubercle bacilli were found in the tissue, but sections showed typical tubercles with giant cells. The patient made an excellent recovery and after eighteen months shows no symptoms of recurrence. Tuberculosis of the breast is undoubtedly rare. It may be either primary or secondary. Slight trauma is usually an exciting cause, as in the case described. The characteristic symptoms are the rapidity of the disease process (the patient was operated within a month after the initial symptoms), early fistula formation, involvement of lymph nodes and pain when inflammation exists. The treatment is breast amputation and excision of the affected glands. The prognosis is good where the breast lesion is primary; in secondary cases it depends upon the primary focus.—*Tuberculosis of the Breast, E. P. Hamilton, Surg. Gynec. & Obst., June, 1920, xxx, 567.*

Tuberculosis of the Joints.—Thirteen cases operated for joint tuberculosis are reported. All were of an advanced character in which conservative treatment had failed to cure. In every case the diagnosis was established beyond a doubt before operation. Radiography and the subcutaneous tuberculin test were used as diagnostic aids. In all cases a preparatory period of treatment extending from one week to two months gave opportunity for closer observation. The patient's general resistance was built up by fresh air and feeding. In most cases tuberculin treatment was also given according to Sahli's method. Whenever feasible, joints were operated under Esmarch constriction; Kocher's technic was generally followed in making incisions. If the disease was confined to the synovial membrane, this membrane alone was removed, avoiding complete ankylosis. If the bone was involved, however, the bone ends were exposed, diseased tissue carefully removed, and the bones placed in good apposition. In every case iodoform powder, previously boiled for half an hour in a 1 to 500 bichloride solution, was rubbed into the entire wound surface, and the bone and the soft tissues, and the superfluous part washed away with physiological saline solution. A plaster of Paris cast was put on before the Esmarch bandage was released The wound was drained by rubber tubes surrounded by washed-out iodoform gauze strips, which were removed through windows in the cast within a week. The first cast was quite heavy and was worn from four to six weeks, after which time patients with lesions in the lower extremity were allowed to leave the bed, wearing a lighter cast. This second cast was worn for two or three months. A much shorter time was needed after operations on the upper extremities. No amputations were necessary. In a case of resection of the elbow joint, a second operation was done for fistula which resulted in a cure. The author regards Rollier's heliotherapy as of undoubted value in joint tuberculosis and believes that institutions should be established where this treatment can be used carefully and intelligently. As two to three years are necessary for a cure by Rollier's method, there may always be patients who cannot spend so long a time in an institution. In such cases operation may be preferable, as the ability to work with a painless limb will outweigh the drawback of an ankylosed joint.—*Tuberculosis of the Joints, G. Schwyzer, Surg. Gynec. & Obst., June, 1920, xxx, 581.*

Injection of Tubercle Bacilli into the Metaphysis of the Long Bones in Animals.—In order to study the cellular reaction of bone to tuberculous infection a series of experiments was made with rabbits and guinea pigs. The animals were given 20 cc. of a 1 per cent solution of trypan blue intravenously, and, two days later, one or two drops of a physiological salt emulsion of tubercle bacilli were injected through a trephine opening in the metaphysis of the tibia. Bovine bacilli were used in rabbits, human bacilli in guinea pigs. The animals were killed at varying intervals, generally in three to nine days, and portions of the bone removed and fixed in formaldehyde. The marrow was then removed, embedded in paraffine and stained. In all the animals it was possible to demonstrate either the bacilli, definite tubercles and giant cells, or diffuse caseation, depending on the length of time the animal lived after infection. Animals killed three days following infection showed no bone lesions macroscopically. Under the low power the lymphoid cells were decreased in number and reticulo-endothelial cells more numerous near the trephine opening. With higher magnification, a large number of leucocytes showed nuclear degeneration, while the reticulo-endothelial cells contained two or more nuclei, were rounded in shape and lay free in the marrow. In stained sections it was possible to demon-

strate one or more tubercle bacilli in the clear areas, evidently vacuoles of these cells. In later stages of infection, groups of reticulo-endothelial cells were seen, consisting of ten to twenty cells, containing tubercle bacilli and undergoing the changes described. It could not be definitely determined whether these cells had proliferated in situ or wandered to the point of infection. Probably both these methods of increase occur. A few giant cells of the Langhans type were seen, which also contained acid-fast bacilli. In animals allowed to live a month after infection, extensive tuberculous lesions were found in the infected bones, consisting of broad areas of caseation surrounded by granulation tissue. The experiments indicate that the difference between these localized tuberculous lesions, and the diffuse lesions seen in pyogenic infections are due to peculiarities in the infected tissue, the bone marrow. This tissue in the metaphyses of long bones as contrasted with the fatty marrow of the diaphyses, is rich in the cells that are especially concerned in the reaction to infection with tubercle bacilli.—*Early Changes Following the Injection of Tubercle Bacilli into the Metaphysis of the Long Bones of Animals, J. Oliver, J. Exper. Med., August, 1920, xxxii, 153.*

Tuberculosis of the Genitourinary Tract.—Tuberculosis of the kidney presents many difficult problems, some of which are discussed. The most prominent symptom is irritability of the bladder. In all cases where the disease is near the kidney pelvis there is a discharge of bacilli into the urine. In many cases the diseased kidney can be felt and tenderness over the bladder is occasionally elicited. Urination is frequent. The urine is usually light colored, turbid, and contains traces of albumin, many pus cells and usually a few red cells. The importance of radiographs in the diagnosis of renal tuberculoss is being felt more and more, and cystoscopic examination is of prime importance. The anesthesia of choice is gas and oxygen. The diseased kidney is to be removed. The question of treatment of the ureter is still in debate. The author personally cuts the ureter where it is most convenient and treats the end with carbolic acid and alcohol and drops the ureter back to take care of itself. He prefers not to drain. The irritability of the bladder begins to improve. If, at the end of a few months, the bladder has not regained its normal capacity, it can be improved by gradually dilating it once or twice a week with mercuric chloride, 1 : 50,000. The general hygiene should be looked after and the patient should sleep out of doors if possible. Tuberculosis of the bladder is always secondary to tuberculosis of the kidney. Tuberculosis of the penis is very rare. Tuberculosis of the epididymis is always associated with disease of the seminal vesicles and prostate. Most of these cases do well under hygienic treatment, fresh air, plenty of rest and good food.—*Diagnosis and Treatment of Tuberculosis of the Genitourinary Tract, A. H. Crosbie, Boston M. and S. J., July 29, 1920, clxxxiii, 134.*

An Unusual Case of Tuberculous Salpingitis.—This case is of interest because the condition was not recognized before operation, at the time of operation, nor even when the specimen had been removed. At the time of admission the diagnosis was tubo-ovarian abscess. After opening the abdomen the diagnosis was changed to tubal pregnancy, unruptured. Only after the mass had been cut open was the diagnosis of bilateral tuberculous salpingitis, chronic appendicitis and corpus luteum cyst of the right ovary made. The history of the patient is as follows: A married colored woman, aged nineteen, complained of pain, swelling and tenderness in the right lower abdomen. She had had pneumonia at fourteen and influenza at eighteen. Constipation had been present for many years. There was nothing of importance in the menstrual history. No leucorrhea had ever been noticed. The patient had been married for three years but had never been pregnant. Physical examination: Anterior and posterior cervical lymph nodes were enlarged. The lungs were normal. The abdomen showed definite tenderness all over the lower part, most marked on the right side. The body of the uterus was found to be in mid-position, of normal size and consistency but pushed over to the left side. Filling the right half of the pelvis and bulging into the pouch of Douglas and also into the rectum was a tense, smooth, cystic mass, adherent and tender. The urine was negative. Wassermann negative. A diagnosis of chronic pelvic inflammatory disease with abscess on the right side was made. Under ether the pelvic examination revealed the following: The body of the uterus was of normal size, in good position, and freely movable. On the right side were two distinct masses. The left ovary was slightly enlarged. The diagnosis made from this examination was tubo-ovarian abscess. Operation: A pelvic puncture was done but no fluid was obtained. A midline abdominal incision was made, the uterus was elevated and found free from adhesions, of normal size and consistency. By careful dissection the upper mass on the right side was released together with the entire length of the Fallo-

pian tube. The latter with a wedge of uterine cornu was resected without rupturing the lower mass. This was by far larger and proved to be a corpus luteum cyst. Only a portion of the cyst was excised together with the right ovary. On the left side, the tube alone with a wedge of uterine cornu was removed. The appendix was then resected. The diagnosis now given was tubal pregnancy, unruptured. The gross and microscopic examination revealed throughout the stroma typical tubercles of varying sizes. Only then the correct diagnosis was made.—*An Unusual Case of Tuberculous Salpingitis, J. P. Greenberg, Bull. Johns Hopkins Hosp., April, 1920, xxxi, 132.*

Venous Murmur, Probably of the Azygos Major, in a Consumptive.—A patient with pulmonary tuberculosis presented a venous murmur, heard best at the level of the second dorsal vertebra, between the vertebral column and the right scapula, and heard distantly at the right infraclavicular fossa. The murmur was continuous and was intensified with systole and on deep breathing. From its location, its intensity and its absence in the jugular and subclavian veins, it is most probable that it originated in the only other vein of any size in that vicinity, namely the azygos major. The cause of the murmur is probably compression of the vein by enlarged tracheobronchial lymph nodes or deviation of the course of the vein due to pleural adhesion.—*Caso Rarisimo de Soplo Venoso, probablemente de la Azigos Mayor, en un Enfermo de Tuberculosis Pulmonar, M. Darder Rodes, Arch. Espanol. de Tisiolog., May, 1920, i, 217.*

Syphilis and Tuberculosis.—Mariño and Mussio have sometimes obtained surprisingly favorable results in the treatment of tuberculous patients when tentative treatment for syphilis was given to supplement the usual measures. Even where there is nothing to suggest syphilis asthenia, status lymphaticus or other endocrinopathy may be manifestations of an inherited or acquired taint, and justify mercurial or other treatment with small doses. This is liable to be of inestimable value when the parents are robust and free from lead poisoning, malaria, etc., which might have affected their offspring, the probability of inherited syphilis as responsible for the endocrinopathy in such conditions being particularly evident.—*Apuntes clinicos sobre sifilis y tuberculosis, E. E. Mariño and J. C. Mussio Fournier, Sem. Med., January 29, 1920, xxvii, 170.*

Hookworm and Tuberculosis.—Information with regard to mistaken diagnosis in the case of tuberculosis and hookworm is contained in a preliminary report received by the War Department on a study conducted by army medical men at General Hospital No. 19, at Oteen, N. C., where tuberculous patients are treated. The report says that many cases which had been diagnosed as tuberculosis on further examination showed signs of hookworm, and under treatment for hookworm the patients improved greatly. Accurate figures as to the number of hookworm cases which had shown all the evidences of tuberculosis will soon be compiled. It is estimated that about 10 per cent of the patients suffer from hookworm at the time of admission and that about 2 per cent do not have tuberculosis.—*News Item, N. York M. J., August 7, 1920, cxii, 197.*

Syphilitic and Tuberculous Joints.—The author has observed more than two hundred cases of chronic destructive joint disease diagnosed as tuberculous, but which were evidently syphilitic because of their response to mercury and potassium iodide, suggestive family histories, and dental stigmata in many of the cases. In 51 of the cases a diagnosis of tuberculosis had been made by 26 surgeons, and the patient had been under treatment for six months to twenty-five years, yet all showed marked improvement under the use of mercury and potassium iodide, and many became symptom free. The symptomatology and radiographic findings of the two diseases are so nearly alike that it is often impossible to make a differential diagnosis. Besides, in such late manifestations of inherited syphilis the Wassermann reaction is rarely positive. In doubtful cases, the best method is to push antisyphilitic treatment to the limit of tolerance. The orthopedic treatment of the two conditions differs somewhat. In tuberculosis a firmly ankylosed joint is generally desirable, as tissue regeneration is not to be expected; but in syphilis replacement of necrotic bone areas may occur. Hence, weight-bearing joints should not be maintained indefinitely in plaster casts, but removable braces should be used, that will allow motion when patients are lying down; also removable splints for the upper extremities. Five cases are reported in detail illustrating the value of specific treatment in chronic joint disease with inherited syphilis, that had been diagnosed and treated as tuberculous.—*Syphilitic and Tuberculous Joints, P. W. Roberts, J. Orthop. Surg., May, 1920, xviii, 265.*

Treatment of Pulmonary Tuberculosis.—The author disputes the claim that sanatorium treatment has failed and that we

have no cure for pulmonary tuberculosis. The most successful treatment thus far is that which is lauded under the heading of "rest and exercise treatment" or "treatment by controlled autoinoculation"—the bed-rock of the sanatorium. The most frequent cause of failure is the delay in diagnosing the disease at a reasonably early stage. So long as the fatal reliance on the stethoscope as the instrument par excellence for early diagnosis remains, so long will deep-seated or hilum tuberculosis be constantly missed in its earlier stages. Furthermore, patients often fail to consolidate their gains after departure from the sanatorium. The so called rest and exercise treatment has two classes of followers, first, the German school favoring the "Liegekur" or absolute rest plan, led by Brehmer, Dettweiler, Cornet, Turban, Penzoldt and in America by Trudeau, and the systemic exercise therapists (consisting of graduated walks) favored especially by Walther and Paterson. Common agreement rules that rest is the right treatment for all cases of decided fever. Both rest and exercise are of vital value, each in its proper place. For very active tubercle with a tendency towards caseation rather than fibrosis, careful avoidance of autoinoculation, to the exclusion as far as possible of all reactions, is the line of treatment which should be followed. Fever must not be made the sole indication, as is perhaps too often done, but the type and extent of lesion should also be taken into account. At the other end of the scale are cases with a marked tendency towards fibrosis and healing, and it is among these that exercise pushed even to decided autoinoculations in some cases, is not only safe but beneficial. Even among these however, definite hours of rest must be enforced. The whole of this controversy between the various schools is the absolute need in tuberculosis of individual treatment and the avoidance of the fetich of a fixed routine. Chronic cases of pulmonary tuberculosis may also derive benefit from reactions produced by other means. Certain heavy metals, particularly copper and gold and to a lesser extent nickel and cobalt, are held to exert a specific action on tuberculous tissue. They exert a two-fold action, by destruction bit by bit of the tuberculous focus, and a stimulation of immunity by release of antigen. The Lutons used preparations of the salts of copper internally and externally and found that focal and general reactions followed these preparations with subsequent general improvement. The latest intravenous preparation is dimethyl glycocol-copper used with good results by Bodmer, Sorgo, Schlau and Landolt. The treatment should be confined to chronic and afebrile cases only. Von Münch used copper formate intravenously with good results. For skin tuberculosis a cinnamic acid-copper-lecithin preparation called lecutyl is used locally. While different observers report variable results, the general agreement seems to be along the following lines: 1, Copper salts possess a selective action for tuberculous tissues. 2. We are able to get copper into contact with tuberculous tissues by general administration and to cause both focal and general reactions. 3. Such reactions tend to be followed by local and general improvement, provided they are applied to selected cases, to the exclusion of acute, very active and progressive tuberculosis. The most important exponent of gold therapy is Feldt of Frankfort who succeeded in turning out a gold cyanide preparation known as krysolgan which is administered intravenously in 10 per cent solution and claimed to be as near a specific as possible. It has been largely used in combination with therapeutic tuberculin. —*Some Thoughts on the Treatment of Pulmonary Tuberculosis, C. Riviere, Tubercle, August, 1920, i, 490.*

Heliotherapy in Surgical Tuberculosis.—Heliotherapy in surgical tuberculosis should be regarded merely as an adjuvant in conjunction with other conservative measures and in certain cases even radical measures. Sunlight stimulates and enlivens, and this therapeutic value is enhanced by its psychological effect. Rollier has brought the importance of insolation into special prominence although he is somewhat over-enthusiastic. He claims that high altitude is essential with low atmospheric pressure, infrequency of winds, marked dryness of atmosphere, little fog, low rainfall, prolonged duration of sunshine, high actinic value of sunlight augmented by reflection from the snow, intensity of heat rays and pure air of high radioactivity. Some authorities advocate insolation at the seaside as the light effect is greatly increased by reflection from the sea. Most observers are agreed that sunlight when obtainable is preferable to light from artificial sources. Wieszner has demonstrated that the long-wave red rays possess not only strong bactericidal properties but also have the greatest penetration capacity, while the ultraviolet rays will not traverse the skin. The value of insolation may be summarized as follows: 1. Heliotherapy has a beneficial direct action which is bactericidal and useful in so far as it stimulates a suitable local inflammatory response. Too short-waved rays are dangerous as they may produce

superficial necrosis and should be screened if artificial light is employed. Local treatment is of value especially in cutaneous tuberculous lesions, lupus, ulcers, pustular eruptions and the like. 2. The remote beneficial effects of sunlight appear to be dependent on the ability of the skin to pigment satisfactorily after properly graduated exposure on as large an area of the body as possible. Failure or success in obtaining pigment formation furnishes us with the most valuable guide to prognosis in joint tuberculosis. Pigmentation is helpful according to Rollier by its tonic effect, its metabolic action, while most valuable in all cases perhaps its help in the treatment of sinuses and ulcers and in the elimination of the sequestra and its value in restoring mobility to healed joints fixed by fibrous ankylosis. 3. It is of great value in the after-treatment of patients. 4. It reduces the length of treatment required in cases that pigment satisfactorily. 5. It is often of most striking value in patients who are already improving—here it may be called a great accelerator of cure. Heliotherapy is useless for the treatment of patients who have no pigmenting power, except as regards the local treatment of superficial lesions, in cases of amyloid disease, in acutely septic cases with pyrexia and in patients suffering from complicating nontuberculous conditions in whom insolation is contraindicated. The author gives detailed instructions for the conduct of the sun treatment as employed in the Treloar Cripples Hospital at Alton, Hants. Excessive reactions should be avoided and insolation should be gradually applied. While a patient is undergoing the treatment he will derive the greatest benefit if the normal course of his existence is interfered with as little as possible.—*The Rôle of Heliotherapy in Surgical Tuberculosis. H. Gauvain, Tubercle, June, 1920, i, 401.*

Light Treatment of Tuberculosis.—Strauss obtained poorer results in open tuberculosis of bones and joints than Rollier. Therefore in a mixed infection he always found it first necessary to operate and then follow it with light treatment especially in affection of lymph nodes. Lupus gave good results under general radiation. Good results were obtained in pulmonary tuberculosis of a mildly active stage, better from sunlight than from X-ray, and best from a combination of both. Pigment is the factor in sunlight treatment and one should try to produce it. Best results were obtained in brunettes.—*Über Strahlentherapie der Tuberkulose bei der östlichen Bevölkerung, S. Strauss, Strahlentherapie, March 5, 1919, ix, 81.*

Heliotherapy and Phototherapy.—Vevey uses a heliophore which consists of a large glass lens, doubly convex, mounted in a linen barrel-shaped apparatus held on a tripod, so that the sun rays are caught and brought to a focus from 6 to 8 inches in diameter, depending on the amount of heat obtained. This intensifies the sun rays, allows the warm end of the spectrum to penetrate, and shuts out most of the other rays. He applies this treatment in every type of tuberculosis and gives enthusiastic reports. Cervical glands disappear after five hours' exposure. Of 263 cases, 85 of them with suppuration, all rapidly improved and very few relapsed. His pulmonary cases never had hemoptysis, but he is careful to keep his patients on a vegetarian diet. In laryngeal tuberculosis the pain stops and the ulcerations heal rapidly. The heat rays accomplish the results. Sixty per cent were cured.—*Héliothérapie et photothérapie, S. A. de Vevey, Bull. gen. d. thérap., April to September, 1918, xxii–xxiv, 1.*

Quartz Light in Pulmonary Tuberculosis.—The author studied eleven cases that had seventy periods of quartz light treatment, devoting special attention to blood pressure, pulse and respiration. The results were a lowering of blood pressure in the majority of cases, but no conclusive change in the pulse rate or the respiratory rate was noted.—*Über einige Wirkungen der Quarzlampenbestrahlungen bei Lungentuberkulose, H. Austgen, Beitr. z. Klink. d. Tuberk., July, 1919, xlii, 18.*

Effect of Quartz Light on Internal Organs.—Mice were exposed to quartz light up to twelve and fourteen hours. At the end of this time necrosis of the ear and marked irritability developed, so that the time of exposure was not extended. Very definite changes took place in the internal organs of these animals, with necrosis and hemorrhage and dilatation of vessels, probably due to the direct penetration of the ultraviolet rays. A few animals that were exposed to the red lamp did not develop these changes.—*Experimentelle Studien über die biologische Wirkung des Quecksilber Quartzlichtes auf die inneren Organe, R. Gassul, Strahlentherapie, March 5, 1919, ix, 232.*

Ray Therapy in Pulmonary Tuberculosis.—The quartz light is valuable in stationary, nonprogressive cases of pulmonary tuberculosis, especially if used in combination with X-ray treatment. All progressive and acute destructive cases, and even those with merely a tendency to fever, are not suitable. It is necessary to dose the

treatments accurately although sunlight is much more dangerous than the quartz lamp. Healed cases that were overexposed to sunlight, redeveloped activity. The quartz lamp works by relieving the lungs of the blood, and then allowing the blood to return in time. At times the heat rays were added to the quartz light. Bacmeister speaks of 700 stationary cases treated with the X-ray. He advises extreme caution. X-ray technic is discussed in detail.—*Über die Anwendung der Strahlentherapie bei der menschlichen Lungentuberkulose, A. Bacmeister, Strahlentherapie, September 10, 1919, ix, 556.*

Ultraviolet Rays in Scrofulous Eye Conditions.—The entire body of the patient was exposed to quartz light; and the uviol lamp was locally applied to the open eye. They can be used singly or in combination. The curative results are good.—*Allgemeine und lokale Bestrahlung mit ultraviolettem Licht bei skrofulösen Augenleiden, A. Passow, Med. Klin., May 10, 1919, xxxiii, 1307.*

Light and its Use.—The quartz lamp is not a good substitute for sunlight because it contains too many of the short irritating ultraviolet rays. The carbon arc lamp is much better, as this contains the red end of the spectrum which is absent in the quartz light, and the red end is important. The ultraviolet rays are directly absorbed by the cell protoplasm and act in this way, but the red rays make the cells sensitive so that they absorb the ultraviolet. The warm rays dilate the skin vessels and can directly affect the hemoglobin. The pigment developed in the skin cells also acts as a sensitizer. One cannot use the quartz lamp for sufficiently long periods of time because the short ultraviolet rays present are too irritating for long exposures. The author mentions the various spectra and also the advantages and disadvantages of the various modifications of the carbon arc lamp.—*Licht und Lichtbehandlung, F. Schanz, Strahlentherapie, September 10, 1919, ix, 544.*

High Altitudes and Heliotherapy.—The writer mentions correspondence held between himself and Rollier in 1904 after the sunlight treatment of surgical tuberculosis had been started. He discussed various methods of measuring the intensity of the different parts of the sunlight spectrum, also the measurements of direct sunlight and diffuse daylight, the amount of sunshine and the warm and ultraviolet rays, the influence of the atmosphere and the time of the year and the altitude. Langley's percentages of the different rays penetrating atmospheres at high and low altitudes are given. The greatest amount of ultraviolet radiation occurs in the summer time and after that in the spring, as is shown by the amount of pigmentation developed at that time. This is in contradiction to Dorno who says that after the summer, the greatest amount of radiation is in the fall and then the spring and winter. He emphasizes the importance of the ultraviolet rays. The warm ray plays a part in setting up a hyperemia. From comparisons of the light intensity near the shore, in the Alps, and in the desert it appears that high altitude is the location of choice, and second to that is the sea coast. The advantages of high altitude are greater intensity of ultraviolet radiation; increase of red cells, hemoglobin and metabolism; freedom of the air from moisture; dust and bacteria; cold, dry, snowy winters; summers not too hot; scarcity of wind; protection by peaks; and a great amount of light.—*Das photochemische Klima, im besonderen des Hochgebirges und seine Beziehungen zur Heliotherapie, O. Bernhard, Strahlentherapie, September 10, 1919, ix, 520.*

Thoracoplasty.—The need of a suitable method of operation for the many patients on whom the pneumothorax treatment could not be performed prompts the author to replace the extensive and dangerous Friedrich operation of extrapleural thoracoplasty or total resection of the bony chest wall by a smaller operation with the removal of the hindmost pieces of ribs only, under local anesthesia. This has changed an operation having a mortality of 25 per cent to one of comparative safety. Indications for thoracoplasty have been the same as those for pneumothorax treatment, no patient being operated on in whom a pneumothorax had not been previously tried without result. The operation is contraindicated in severe tuberculous disease outside the air-passages, in other severe systemic diseases threatening the patient's life, in great debility, in acute and rapidly progressive cases, and in intolerance to novocaine-suprarenin. Most suitable for the operation are chronic fibroid cases without severe acute symptoms with more or less extensive cavities; cases of a sclerosing or destructive character in the lower lobe which usually have a bad prognosis and in which the pneumothorax method, though practicable, often fails; those which relapse after resorption of the gas following repeated artificial pneumothorax; and those with extensive pleural adhesions. Patients whose heart and lungs have become accustomed to compression stand thoracoplasty particularly well. The line of incision begins posteriorly a few cm.

away from the spine and running parallel to it, thence descending downward and forward along the tenth or eleventh ribs as far forward and upward as necessary. A 0.5 per cent solution of novocaine-suprarenin is injected subcutaneously along the line of incision. Each intercostal nerve is anesthetised as well as the intercostal space. An average of 130 to 150 cc. of the solution may be used during an operation without any bad effect. The ribs may then be laid bare without pain and stripped of their periosteum. If necessary the operation is done in two sittings removing the lower ribs first in order to avoid aspiration of the secretion of cavities into an uncompressed lower lobe. The resected ribs include the first to the eleventh, cutting the posterior ends of the ribs as near the transverse processes as possible. It does not greatly matter how far the sternal end is carried forward. Total thoracoplasty is very exhausting to the patient and must be quickly performed. After operation the capacity of the half-chest was diminished to one-half or one-third of the other side and a convex scoliosis towards the diseased side nearly always develops. The influence of the operation on the disease in successful cases is often very marked. Cough and expectoration markedly diminish or disappear, the bacilli in the sputum fare likewise, and the temperature gradually becomes normal. Very little dypsnea results from the operation. Stethoscopy reveals medium or loud râles in the larger bronchi due to incomplete compression. Of 40 cases operated on in Vejlefjord Sanatorium, Denmark, from October, 1916, to June, 1919, 12 were still in the sanatorium considerably improved, 4 died in consequence of the operation, 5 died of pulmonary tuberculosis in spite of the operation, the better lung being so affected as to render them hopeless, 2 patients were worse, and 4 improved. The remaining 13 were fully restored to health and able to work.—*Thoracoplasty in the Treatment of Pulmonary Tuberculosis, C. Saugman, Tubercle, April, 1920, i, 306.*

Surgical Treatment of Pulmonary Tuberculosis.—There are three main indications for operative treatment: 1. The quality of the individual resistance of the patient: We cannot measure the individual resistance of a patient but we know that is constant; therefore by watching the patient we can estimate it. It may be said that when the maximum total of resistance which can be obtained is insufficient to control the disease, surgical treatment, if practicable, is strongly indicated. It does not follow that if the maximum total is adequate for control, surgical treatment is unnecessary. 2. The character and extent of the mechanical changes: The most constant and characteristic change is the formation of fibrous tissue. So long as the shrinkage due to the fibrosis is limited to an amount which can be easily compensated for by surrounding tissues, the case may be regarded as in the earlier stage. But when the shrinkage has passed beyond this limit, a progressive dilatation and distortion of the bronchial tubes take place, producing a condition known as secondary bronchiectasis. Medical treatment cannot do much to compensate for the abnormal mechanical conditions which are responsible for this. By surgical treatment it is possible not only to diminish but even to abolish the symptoms due to these secondary changes. It can diminish the symptoms of bronchial dilatation and distortion. 3. The arrest of certain special symptoms, haemorrhage and pain: Surgical treatment can be used to arrest pain by separating the two pleural membranes from each other by the injection of gas into the pleural cavity. Movements of the lung can be reduced by keeping the patient at absolute rest in bed, but this does not abolish the normal movements of respiration and the movements associated with coughing. The methods of treatment devised to abolish movements of the lung are precisely those most suitable to compensate for the abnormal mechanical changes in the lung and in the chest, and are also most efficient for the arrest of haemorrhage. The beneficial effects of lung collapse are well known. This method cannot be used in cases where indications of a failing heart exist or albumen is constantly present in the urine. There are two methods of obtaining collapse of the whole of the lung—nitrogen displacement (artificial pneumothorax) and rib mobilization. There are two methods of producing collapse of a portion of the lung—local replacement by foreign bodies and paralysis of the diaphragm by section of the phrenic nerve. Artificial pneumothorax is not a serious undertaking from the patient's point of view. When collapse of the lung by rib mobilization is considered, the selection of the case requires the greatest care and consideration. The operation for the collapse of the chest wall and of the lung is done in two stages. At the first stage some three to five cm. of the posterior parts of each of the first nine or ten ribs are removed. At the second stage, the costal cartilages of the first to the seventh rib inclusive are removed. The anaesthetic is of great importance. Ether must not be given to patients with pulmonary tuberculosis. Chloroform is more suitable. The interval of time which elapses between the

first and second stages depends upon the degree of reaction after the first operation. The greatest advantage is obtained if the second can be done ten days after the first stage. Partial collapse by replacement by a foreign body is applicable to those cases in which the disease is localized to the upper lobe. An incision is made through the third intercostal space down to the parietal pleura. This is stripped off the inner surface and of that part of the chest wall overlying the upper lobe. The collapsing part of the lung leaves a considerable space between it and the chest wall which is then filled by some foreign unabsorbable substance. Paralysis of the diaphragm by section of the phrenic nerve is of value in cases where there is considerable fibrosis in the lower lobe and in which bronchial dilatation and distortion have developed. As to the division of the first costal cartilage, the balance of evidence is against the probability of the operation producing any material benefit in cases of apical tuberculosis.—*A Consideration of the Treatment of Pulmonary Tuberculosis by Surgical Intervention, H. M. Davies, Tubercle, February, 1920, i, 15.*

Artificial Pneumothorax.—The end results are presented of 54 advanced cases running over a period of eight years from the Berks and Bucks sanatorium, England. All were advanced or acute cases with unilateral involvement. In 12 it was not possible to establish the treatment because of pleural adhesions. Ten of these have subsequently died. In 42, treatment was feasible. Twenty-one of these subsequently died. Twenty-two of the entire number showed a marked and definite improvement. Of the latter, 8 are dead and 1 is going downhill, while 13 returned to their former occupations or to a moderately useful life. These results were obtained when all else seemed hopeless (2 arriving in a dying condition) and even the 8 that died enjoyed a period of betterment for a year or more with subsequent relapses. The treatment has its best chance in a sanatorium where encouraging object lessons are always on hand as patients are helped more by seeing good results "in the flesh" than by any explanation of theory. No other procedure offers as good a hope of improving the dreary lot of an advancing case of phthisis as does the successful induction of an artificial pneumothorax.—*The Value of Artificial Pneumothorax, Esther Carling, Tubercle, June, 1920, i, 411.*

Necropsy after Induced Pneumothorax.—Necropsy showed the complete cure of the tuberculous cavity in the lung treated by induced pneumothorax for thirty months. Death was due to intercurrent influenzal pneumonia in the other lung Slight tuberculous lesion in the latter had healed likewise. The healed tuberculous lesions were of the torpid, cheesy type. Burnand's experience indicates that the minimum period for effectual collapse therapy in advanced cases is two or three years. He adds further that fourteen of his twenty pneumothorax patients passed unscathed through intercurrent influenza; six died.—*Tuberculose cavitaire chronique; pneumothorax artificiel; decès par grippe; autopsie, M. R. Burnand, Bull. d. l. Soc. Méd. d. Hôp., November 21, 1919, xliii, 983.*

Treatment of Surgical Tuberculosis.—The combined treatment of surgical tuberculosis by sunlight, passive hyperemia and the internal administration of iodine in the form of sodium iodide gave best results. It is impossible to apply surgical treatment in all cases of bone, joint and gland tuberculosis because of the large number and wide extent of the foci, together with the weakened condition of the patient. The intensity of the sun rays at high altitudes and in the lowlands varies little; so also the period of treatment. Fixation bandages were not necessary. Tuberculin treatment gave best results in the beginning softenings of glandular tuberculosis in children; also in diseases of the bones and urogenital tract. Tuberculin however is not sufficient to accomplish permanent cures in these cases. With heliotherapy unusually severe tuberculosis of the joints has been cured and adequate joint motion restored; patients sixty years old, with severe tuberculosis of the spine, have recovered. In the Hohenlychen surgical clinic in most cases, just after a tuberculous focus has cleared up or even before, tuberculin treatment is instituted to prevent new foci. Sunlight treatment is applicable to all surgical tuberculosis.—*Zur Frage der Behandlung der aüsseren Tuberkulose, E. Kisch, Münch. med. Wchnschr., November 7, 1919, lxvi, 1283.*

Tuberculin Treatment.—Conclusions: In cases of chronic tuberculous ulcers, tuberculides, tuberculous sinuses associated with bone, joint or glandular disease or persisting after operation upon tuberculous foci (peritonitis, salpinigitis, epididymitis, mastitis) tuberculin gives satisfactory results. It may be administered in dispensary and clinic while the patient continues at work. Many of the patients came for treatment at the noon hour from factories and workshops. Small doses apparently give most satisfactory results. B.E. or O.T. were used in a 1 in

100,000 dilution and the dose varied from 0.2 cc. of this dilution to 1 cc. It is a valuable adjunct to surgical measures. The similarity of certain tuberculous specific ulcerative skin conditions is to be borne in mind and a Wassermann test is advisable before undertaking treatment.—*Tuberculin in Treatment with Special Reference to Non-Pulmonary Tuberculosis, J. H. Elliott and C. Sheard, Jr., Transact. Canad. Assn. for the Prev. of Tuberc., xviii, 64.*

Atoxic Antituberculosis Vaccine.—The immunizing process stimulates cellular activity and thereby makes demands on the body which must be met by remineralization and recalcification to compensate for the loss of carbonates and phosphates of lime and magnesia, iron and silica in the lungs and most of the organs of the consumptive. According to Robin the coefficient of demineralization of the healthy person is 30 per cent; of the consumptive in the primary stage, 37 per cent; in the secondary stage, 51.46 per cent; in the third period, 29.64 per cent, the latter being smaller because the body then has little to lose; and in the more affected regions the demineralization as to silica goes as high as 50 per cent. The healthy portions are rich in phosphoric acid and potassium and poor in chlorine and sodium. There is not sufficient nitrogen in the lung for that which is destroyed. Recalcification increases organic resistance and aids in the fibrocalcareous transformation of tuberculous lesions. Other substances necessary for remineralization are potash, iron, silica and manganese. Rénon attributes the demineralization of consumptives to dyspeptic troubles with hyperchlorydra and acid fermentations, Robin to individual predisposition and to bacillary infection. After giving in detail the directions of Robin and Ferrier, the author lays down his own dietetic regimen. The diet of the consumptive should consist of wholesome, nutritious and easily digested food, adapted to individual needs, but not given to excess. Febrile conditions are best combated by a reduction of food. The food given should comprise 105 grams of protein, 50 grams of fats, 250 grams of carbohydrates and 24 cc. of alcohol. The tendency to-day is to feed the consumptive as the ordinary healthy individual, changing the quantity only according to the state of the digestion and nutrition. The patient should live in the country, if possible, in a large room with large windows with shutters to close at night so that he does not get the chill air direct. He should go to bed between 8 and 9 and arise between 7 and 8. A half hour walk after meals is recommended. Sports, games and tobacco should be avoided. Sexual intercourse is dangerous. Prophylactic measures must be very strict. Patients should use special pocket cuspidors, and should cover the mouth with a paper handkerchief when coughing. These should be burned after use. The table ware should be boiled for ten minutes in a solution of soda. Napkins should be sterilized before washing and the same should be done to clothing. Walls and floor of the room should be disinfected every three months.—*Atoxic Antituberculosis Vaccine; Remineralization and Recalcification, J. Davila, Sanidad y Beneficencia, July, August, September, 1919, xxii, 31.*

Occupational Therapy.—Suitable handicrafts taught under proper conditions to convalescent patients with tuberculosis are valuable in many ways. We are realizing more and more clearly the subtle reaction of the mind and spirit upon the body. Discouragement, worry, or grief lessen our vitality, whereas success, happiness and enthusiasm bring us new life and vigor. If this is true in health, how much more so is it true when physical and nervous resistance is impaired by illness? One of the hardest things about an illness is the patient's realization of loss of time, strength and usefulness. If we can lessen this feeling and make the invalid more cheerful by permitting him some occupation, we give him a chance to forget himself. He derives pleasure from this and recovers more quickly. A skilled teacher should be employed and she should be given a reasonable number of patients to teach and should have assistants to prepare materials and design the various articles to be made. The workroom should be cheerful and pleasing in color and decoration. Work done by the invalid should be good in form and color. Work badly planned and poorly executed reacts unfavorably upon the patient. Bed patients can learn to weave in raffia, cotton, silk, or wool, to cut leather for bags, belts, mats, and to make toys. The writer suggests that there be a visting occupational teacher association modelled on the plan of the visiting nurse association so that patients may be given this opportunity in their homes, in small hospitals and sanatoriums.—*Occupational Therapy and Tuberculous Patients, B. Thompson, J. Outdoor Life, August, 1920, xvii, 219.*

Occupational Therapy.—Occupation as a therapeutic measure has only in recent years been developed to the point of successful applicability to the sanatorium treatment of tuberculous persons. Of the four fundamental principles of the cure, namely, proper

food, fresh air, graduated exercise and rest, occupation is directly associated with the last two and indirectly with the food-factor, through its influence upon digestion. Since we know that rest is essential to successful treatment, we need only put the patient to bed to secure this requirement but the degree of rest secured will depend upon the extent to which muscular activity may be minimized and mental contentment promoted. Patients, undergoing treatment, think. Much of the success of the treatment depends upon what these thoughts are. Unfortunately, in many cases, this undirected thought leads to disaster. Worry, exaggeration of personal ills and uncertainty of the future are examples of a mental state opposed to rest. In this case occupational therapy acts as a sedative to the entire nervous system. Useful occupation increases self-respect and self-reliance. The Muirdale Sanatorium at Wauwatosa, Wisconsin, looks upon occupational therapy as indispensable to the morale and discipline of the institution. The patient considers occupation as a privilege and a denial of rights to the workshops as a punishment.—*The Value of Occupational Therapy in Tuberculosis Sanatoria from a Medical Administrative Standpoint, G. L. Bellis, J. Outdoor Life, August, 1920, xvii, 221.*

The Dispensary Treatment of Phthisis.—The following is derived from a four years study of tuberculosis in the county of Middlesbrough with a population of about 125,000 people. A patient is kept under observation till death or till he may be considered safe, e.g., till after two years of ordinary life without the display of any tendency to the increase of the tuberculosis incidence. Nurses are the keynote of this system. There should be one nurse to every 30,000 and one doctor to every 60,000. By this method, the death rate has been reduced from 95 deaths in 1914 to 69 deaths in 1918, excluding those below sixteen. The after care of patients is also considered. The total costs of the dispensary are somewhere between three and five pounds per case treated, whereas sanatorium treatment amounts to five times as much per patient. The whole question can be summed up as follows: 1. The dispensary system, properly carried out, should be the main line of defence against tuberculosis, as being both essentially efficient and economic. 2. Sanatoriums for early cases are valuable as a direct aid to dispensary treatment. 3. The theories of advanced tuberculosis should be reconsidered. 4. An effort should be made to find out how much acute pulmonary tuberculosis exists. 5. The reasons for the failure of early notification should be investigated. 6. The present form of statistics should be revised.—*The Dispensary Treatment of Phthisis. What it May Achieve, H. A. Ellis, Tubercle, February, 1920, i, 219.*

The Discharged Soldier and Sanatorium Treatment.—The tuberculous soldier, perhaps more than any other patient, dislikes the ordered routine of sanatorium life, particularly when curtailment of exercise or confinement to bed is necessary. Nothing does more to prevent dissatisfaction among sanatorium patients than the provision of suitable employment. Occupational therapy in the form of technical instruction and employment, should be intelligently adapted to the patient's physical and mental requirements in such a way that interest in treatment will be aroused and maintained. Motor-driving and minor repairs, boot repairing, metal work, basket-making, toy-making, wood-carving, joinery, poultry-farming, bee-keeping, pig-breeding, drug and seed growing, and market gardening are suitable forms of occupational therapy which are within the scope of most sanatoriums. Facilities are also necessary for suitable forms of recreation. It is unwise to conduct a sanatorium on lines similar to a penitentiary.—*The Discharged Soldier and Sanatorium Treatment, G. B. Dixon, Brit. J. Tuberc., April, 1920, xiv, 67.*

Chemotherapy of Tuberculosis with Particular Reference to the Cerium Salts Treatment.—The trouble with chemotherapy of tuberculosis is that it is too difficult, and especially it is too slow. The few observations of the inhibitory activity of salts of cerium and some other rare earth metals (especially samarium, neodymium and praseodymium) were made on the growth of tubercle bacilli in cultures, possibly because they are rare substances and had not yet been shown to be valueless in tuberculosis. According to the figures given, the inhibitory action of these salts is not at all high, about one to five parts per thousand being required to prevent growth, which may be contrasted with gold chlorid, which inhibits when in dilution of 1:2,000,000, and yet which in the careful studies of DeWitt, as in the earlier observations of Koch, could not be made to show any favorable influence on tuberculosis in animals. Innumerable substances have a more powerful inhibitory effect on tubercle bacilli than these rare earth salts. Much is made of the reduction of the fat content of the tubercle bacilli grown on mediums containing these salts, the fat being reduced, it is said, from 25 to 40 per cent to 16 to 22 per cent; but we know

of no evidence that such variations in fat content have any significant relation to the virulence of the tubercle bacillus for man. As far as we can learn, no attempts were made to determine the capacity of the salts of the rare earths to kill tubercle bacilli, and there is no report made of any systematic study of their effects on experimental tuberculosis in animals, in which alone accurate controls can be made. We merely have the statement that on the basis of this slight inhibitory effect in cultures, and, what is perhaps more important, a capacity to cause a mononucleosis, a small number of cases of human tuberculosis have been treated with cerium salts by repeated intravenous injections. These cases, less than a hundred in the reports published, have now been observed at most a few months, and it is believed that cutaneous, glandular and chronic afebrile tuberculous pulmonary lesions have been improved, and that patients with active pulmonary tuberculosis have been made worse. There is no mention of control patients given the same general care without the salts. Possibly cerium earth salts help the tuberculous. The evidence so far presented, however, is nothing to get excited about. Many other agencies, now forgotten, have had as much and more reported in their favor at this stage of their history. We cannot find support for the statement of Rénon: "The results obtained by Grenet and Drouin with the sulphate of the cerium earths are certainly the most scientific yet realized in the chemotherapy of tuberculosis." We find much more support for the closing statement of Paul Lewis's address: "Certainly it will be a most unfortunate thing for the progress of tuberculosis research if every substance showing interesting properties in the laboratory is immediately rushed to the clinic regardless of consequences. In this situation patience is to be taken more than usually as an evidence of virtue."—*Editorial, J. Am.M. Ass., July 24, 1920, lxxv, 246.*

Vegetable Proteins in Pulmonary Tuberculosis.—In 20 cases of pulmonary tuberculosis treated with vegetable proteins the results were not uniform, due to the type of cases, the doses and intervals at which the injections were given and to the coöperation given by the patient. The complete history of two of these cases is given. The dose and the time of injection should be carefully controlled; otherwise, the parenchymatous lung reaction may be more than the patient can stand. Institutional treatment in addition would offer the best chances for improvement. As effects of this treatment we may anticipate reduction of cough and expectoration, a lessened feeling of general tiredness and a tendency towards sclerosis. Proteogen therapy is supposed to produce a bactericidal action upon the tubercle bacillus, dissociating its fatty capsule and eliminating the liberated toxins.—*Contribution to the Treatment of Pulmonary Tuberculosis, E. Zueblin, Med. Rec., July 31, 1920, xcviii, 176.*

Treatment of Tuberculosis with Salts of Cerium.—Several French investigators have for eight years been conducting a research on cerium and other uncommon metals in tentative chemotherapy of tuberculosis. Two facts seem to be established, namely, that the salts of the cerium earths reduce the fats of the tubercle bacillus in cultures to which these salts have been added, and that these salts induce a mononuclear leukocytosis in man and animals. Grenet and Drouin selected the sulphates of samarium, neodymium and praseodymium, and report a year's work with the clinical application of these cerium metals. They inject by the vein from 2 to 5 cc. of a 2 per cent solution for twenty days; then stop for fifteen or twenty days, and then give a second and a third series of injections. They summarize details of 8 cases of tuberculous glands; 10 of lupus; 5 of verrucous tuberculous lesions; 8 of erythematous lupus, and 23 of pulmonary tuberculosis. The external tuberculous lesions healed and chronic apyretic pulmonary tuberculosis showed considerable improvement if not an actual cure. The general health improved, the expectoration became less purulent and less profuse, the physical signs became modified and disappeared and the bacilli sometimes disappeared from the sputum or if they were still found in the sputum they showed extremely pronounced modifications and took stains badly. Three guinea pigs inoculated with these modified bacilli, after losing weight for two weeks, had regained their health by the end of two months. A fourth, recently inoculated, shows no signs of disease, confirming the great reduction in the virulence of the bacilli. Will the latent and well tolerated lesions flare up again? Time alone will tell, but the improvement in all seems to be continuing, and the apparent cure has persisted now for several months. The results, such as they are, are very interesting: a direct action on the bacillus, an action on the human organism by favoring the production of sclerosis, perhaps on account of the enormous mononuclear leukocytosis induced. These cerium salts should be used only in the afebrile cases of pulmonary tuberculosis, stopping at once if fever develops. If these precautions are not ob-

served, discredit may be brought on a method which is still in the experimental stage, but which already seems to offer real hope.—*Traitement des infections tuberculeux chroniques par les sels de terres ceriques, H. Grenet & H. Drouin, Bull. d. l. Soc. Méd. d. Hôp., May 7, 1920, xliv, 589.*

Sulphates of Cerium in Pulmonary Tuberculosis.—The Grenet and Drouin method was followed in twenty cases. Progressive improvement will be the rule, when treatment is applied in the early stage without waiting for advanced pulmonary lesions. As the treatment seems to act on the tubercle bacilli alone, it might be advisable to add some medication to act on the secondary infections.—*Résultats du traitement de quelques cas de tuberculose pulmonaire chronique par les sulfates de terres rames, Esnault & Brou, Bull d. l. Soc. Méd. d. Hôp., May 7, 1920, xliv, 606.*

Salts of Cerium Metals in Chemotherapy of Tuberculosis.—Rénon reviews his eight years of research on a large number of salts of not commonly used metals, hoping to find some that would reduce the virulence of the tubercle bacilli in the organism while rendering the soil of the organism less favorable for its development. The sulphates of some of the cerium metals reduce the fats of the tubercle bacillus from 25 or 40 per cent to 22 or 16 per cent. He mentions other salts which induce mononucleosis in man and animals but are too toxic for clinical use. The results obtained by Grenet and Drouin with the sulphates of the cerium earths are certainly the most scientific yet realized in the chemotherapy of tuberculosis. In controlling their results, their technic must be carefully followed, and the warning heeded that in acute forms of tuberculosis no benefit follows and the lesions may even be aggravated. In the five cases he has just begun to treat, the injections are well tolerated and the leukocytosis has run up from 10,000 to 20,000, 26,000 or 40,000 with from 18 to 23 per cent mononuclears.—*Sur la chimiothérapie de la tuberculose par les sulfates de terres rares, L. Rénon, Bull. d. l. Soc. Méd. d. Hôp., May 7, 1920. xliv, 602.*

Treatment of Tuberculosis by Mycoleum.—Mycoleum is a fatty or oily preparation from organisms of the genus mycobacteraceae or the acid-fasts. Its use was begun in 1908. When a tuberculous patient receives it by hypodermic injections his immunity is raised dose by dose to a higher and higher level, until finally there comes a time when he fails to react and is apparently cured. During the first year there is very little change in the patient but as the injections are continued, being given monthly or in very bad cases every three weeks, the patient begins to show improvement. It may take from one to five years for a patient to be cured, but then rarely is a relapse reported. It takes from three to six months to prepare a dose of mycoleum. This is the reason for its scarcity. If the first three doses do not cause a slight reaction, there is no use of giving any further injections. Miliary tuberculosis and tuberculous meningitis do not react except in the early stages. Continued negative reactions at spaced intervals indicate that the disease has been eradicated. Genitourinary tuberculosis without undue bladder contraction yields satisfactorily to mycoleum. Even if long standing chronic cases cannot be cured, it is possible to enable the patient to live in comfort and to support himself and family and feel well enough to enjoy life. In cases of tuberculosis of the bones and joints, it is necessary to administer from six to twelve doses of mycoleum before drastic surgical measures are thought of. In intestinal cases, one may expect to see an immediate subsidence of such symptoms as gas, tenderness, constipation, rigidity, distention and vomiting together with the severe attacks of pain and often fluid in the flanks. The patient can go about his business and take his doses within reasonable limits. Pulmonary tuberculosis has also done well under treatment. Monthly doses are given, among other reasons because in some cases a marked inflammatory local reaction keeps up for two and three weeks. Eighteen cases are reported.—*Treatment of Tuberculosis, Clinical Case Records, B. S. Paschall, N. York M. J., July 17 and 24, 1920, cxii, 95 and 127.*

Tuberculosis Immunity Among Sulphur Dioxide Workers.—With data collected from 38 of the largest industrial establishments in the United States engaged in the manufacture or handling of sulphur dioxide and sulphuric acid, the author arrives at the following conclusions: 1. The percentage of cases of tuberculosis among workers around sulphur dioxide and sulphuric acid is negligible. 2. Sulphur dioxide and the fumes of sulphuric acid appear to act as preventives of tuberculosis and possibly as a cure in incipient cases, with the exception perhaps of fibroid phthisis. 3. The author welcomes additional data from any source along these lines.—*Immunity to Tuberculosis Among Workers in Sulphur Dioxide, F. Tweddell, Med. Rec., August 21, 1920, xcviii, 310.*

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ABSTRACTS OF TUBERCULOSIS

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The Abstract Editor is Dr. George Mannheimer, 41 West 51st Street, New York City. Prompt transmission to him of reprints or abstracts of papers on tuberculosis, sanatorium or board of health reports, etc., will promote their early publication in this section.

Abstracts should be sent typewritten on one side of the page only. They should be as concise and compact as the subject matter of the article warrants. They should be headed with a short title, and followed by the full title of the paper, author's name, journal, date, volume and page

Public Health Service takes over Army Hospitals.—Two army hospitals, one in North Carolina and the other in New York harbor, will be taken over by the United States Public Health Service during the first week in November, 1920. The North Carolina hospital (O'Reilly Hospital), which is at Oteen, eight miles from Asheville, will be continued as a tuberculosis hospital with about 1000 beds. Dr. W. M. Foster will be in temporary charge. The location of the hospital is beautiful and the institution is admirably adapted to the treatment of tuberculous disease. The buildings were erected by the army for that particular purpose and are superior to most of those in base camps. Two of the wards will be remodeled; and some additional buildings will be erected for the use of the staff, especially the married staff, for whom no accommodations now exist. The present patients will probably remain, if the hospital equipment can be taken over with them. The nurses, except those who wish to take accrued leave, will remain.—*From a bulletin of U. S. Public Health Service.*

To Distinguish Exudates from Transudates.—The authors commend, as very reliable, Sochanski's technic for this purpose. It never failed in the thirty-eight cases tabulated. The reagent is made with 1 cc. each of a 1 per cent solution of phenolphthalein and of tenth-normal solution of sodium hydroxid to which double distilled water is added to a total of 100 cc. To 9 cc. of this fluid is added a drop of the fluid to be tested. The reagent was always decolorized when the fluid was an exudate while the tint remained unchanged with the transudates. The reaction can be made more sensitive by using smaller amounts of the reagent. The findings are more reliable than with determination of the albumin with other tests of the kind, as is shown by the parallel findings with titration and other tests.—*Sockanski's Methode til Adskillelse af Exsudates og Transsudates, R. B. Larsen and K. Secker, Hospitalstid, May 5, 1920, lxiii, 273.*

General Paresis in Tuberculosis.—Roque and Cordier describe a case of apparently typical paretic dementia in a man of fifty with pronounced tuberculosis of long standing and syphilis acquired thirty-four months before death. Necropsy revealed tuberculous meningitis and old tuberculous lesions in the cortex. They do not venture to decide whether the case is one of general paresis masquerading as an ordinary lesion, or whether the tuberculous leptomeningitis produced the syndrome of syphilitic general paresis.—*Du syndrome de paralysie générale au cours de la méningite tuberculeuse de l'adulte, S. Roque and V. Cordier, Paris Méd., May 22, 1920, x, 417.*

Pulmonary tuberculosis: Deaths and death rates, New York State and large subdivisions, August, 1913 to 1920*

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutional districts	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
August average	1913–17	1,052	122.6	646	139.1	406	103.0	196	102.5	210	103.5		
August	1913	1,017	123.1	631	142.9	386	100.4	173	92.5	213	108.5		
August	1914	1,040	123.4	620	137.3	420	108.2	199	104.2	221	112.3		
August	1915	1,081	125.8	699	150.5	382	96.9	193	100.9	189	93.2		
August	1916	1,022	117.1	608	128.0	414	104.1	213	110.0	201	98.4		
August	1917	1,100	123.4	672	138.2	428	106.3	203	103.1	225	108.8		
August	1918	1,003	110.8	563	113.1	440	107.9	183	91.2	215	103.5	42	
August	1919	919	99.5	546	107.2	373	90.5	147	71.9	182	87.1	44	
August	1920	796	84.9	447	85.9	349	83.7	124	60.0	176	83.7	49	

* Deaths per 100,000 population per annum.

Data from New York State Health Department Annual Reports and Monthly Bulletins, or specially computed.

Deaths and Death Rates from Pulmonary Tuberculosis in New York City and State.—The following table, showing the deaths and death rates from pulmonary tuberculosis for New York City and State, for August, during the years 1914 to 1920 inclusive, are taken from the *Monthly Vital Statistics Review, New York State Department of Health, October, 1920, New Series, vol. i no. 8.*

Itinerant Consultation Service.—Consultation service for the detection of tuberculosis had its inception in the Framingham Health Demonstration. It was found that the time of one of their chiefs was being requested regularly by practising physicians. In Barnstable County the resident physician of the county tuberculosis sanatorium acts as consultant. During the first year propaganda carried directly to the people was not attempted. The scheme was to work through the physicians, visiting nurses and the local health board. In the handling of the cases it had to be decided whether to permit discussion in the presence of the patient. Two-thirds of the physicians on Cape Cod have used the consultation service. Five to six consultations are expected monthly. During the year, 148 patients were examined: 77 in the clinics, 71 in consultation; and 27 out of 44 positive cases were diagnosed at first hand by the consultant. The function of the consultant in prognosis and treatment is most important. Twelve out of 58 adults who were found nontuberculous were suffering from asthma. The ratio of dead to living tuberculous has been increased from 1 to 3.5 to 1 to 5. In Provincetown 12 of 13 found tuberculous were Portuguese. The cost of the experiment has approximated $5.50 per examination, or $29 for each case of tuberculosis examined. Until consultation service is lifted out of the experimental stage, any cost is justifiable.—*Itinerant Consultation Service, H. S. Wagner, Boston M. & S. J., September 16, 1920, clxxxiii, 351.*

Rhode Island State Sanatorium Report.—On January 1, 1919, there were 179 patients present. During the year there were 552 admissions and 481 discharges. On December 31, 1919, there were 246 patients. The whole number of patients treated during the year was 738. The average daily number of patients was 232. Of the 481 patients discharged 1 was apparently cured, 6 had their disease arrested, 66 were quiescent, 121 improved, 132 unimproved, and 127 died. Two were nontuberculous and 4 left before diagnosis was made. The average number of patients in the two wards was 88.6. The considerable number of empty beds in both the sanatorium and the hospital (total over 100) is not peculiar to this institution. Late in 1918 and early in 1919 influenza, by absorbing the time of physicians and tuberculosis nurses, reduced hospitalization. High wages encourage home care and reduce morbidity. Eighty per cent of employees on the payroll have had clinical tuberculosis. Follow-up records of ex-patients who have worked at the hospital as compared to those who have worked elsewhere showed that 25 per cent more survived among those employed at the hospital. Among the causes of death asthenia due to tuberculosis was most frequent. Of the contributory causes laryngitis was most frequent, then enteritis, hemoptysis and meningitis. The weekly per capita cost of sanatorium treatment for 1919 was $13.78. The daily cost of raw food per person was about 58 cents. All sanatorium employees except the night nurses and cooks were put on a forty-eight hour week, actual working time, on July 1 of this year.—*Fifteenth Annual Report of the State Sanatorium at Wallum Lake for the Year Ending December 31, 1919, H. L. Barnes, Superintendent.*

A Survey of Sanatorium Benefit.—In July, 1912, no tuberculosis hospital or dispensary existed in Newcastle, and the local Insurance Committee and the City Council decided to enter upon a comprehensive "combined scheme," for dealing with all cases of tuberculosis occurring in Newcastle residents, insured and noninsured alike. The agreement embodying the scheme came into force in November, 1913, and was binding for fifteen years. Under its terms the Corporation agreed: (1) To establish, equip, staff and maintain a tuberculosis dispensary, the medical officer in charge of which should act as medical adviser to the insurance committee in regard to sanatorium benefit. (2) To maintain 30 beds for adult cases of pulmonary tuberculosis at Barrasford Sanatorium, of which 20 were reserved for insured persons. (3) To maintain 30 beds at Stannington Sanatorium for cases of tuberculosis occurring in children below sixteen years of age. (4) To build, equip and maintain two pavilions containing 62 beds for cases of phthisis at the City Hospital, Walker Gate. Summary of report of the interdepartmental committee on tuberculosis (sanatoria for soldiers), August 1919: (1) Approximately 35,000 men have been discharged for tuberculosis. Of these, 18,000 have completed residential treatment and 4,000 are at present receiving it. (2) At present 10,000 to 11,000 beds are available for the treatment of adult tuberculous males

and although ex-service men have priority as regards admission, the number is insufficient. (3) Sanatorium treatment as at present administered is regarded as unsatisfactory: (a) because the period is too short; (b) because the patients return to their old environment and relapse occurs. (4) Tuberculous persons should be dealt with in three stages, continuous with one another: first, the sanatorium, where treatment is mostly emphasized; second, the colony, where treatment is continued but training and graduated labor are the main objects; and third, the permanent village settlement, where permanent employment will be afforded but always under medical supervision. All three should be correlated to one another and should be situated in the same geographical area, e.g., same pensions' region. (5) For advanced cases suggestions are made for the provision of small homes in the larger centres and more ample accommodation in sanatoria. (6) It is desirable to establish convalescent hospitals in suitable localities for certain cases in which Sanatorium treatment is not considered necessary.—*Insurance Committee for the City of Newcastle-upon-Tyne. A Survey of Sanatorium Benefit, July, 1912–December, 1919, W. H. Dickinson, Medical Adviser.*

The Migratory Consumptive.—The indigent migratory consumptive is becoming a more serious economic problem each year, affecting chiefly Colorado, California and the whole Southwest. The average consumptive fails to realize that the progress toward cure is slow, that the climate is vain without rest, good food and a contented mind. Unless his bank account is large he becomes a burden to the community. The majority of consumptives who come to Arizona have come without medical advice. To add to the trouble, comes the discharged tuberculous soldier.—*The Migratory Consumptive as a Financial Burden to the Southwest, A. H. Williams, Southwest Med., September, 1920, iv, 13.*

The Value of a County Tuberculosis Survey with Clinics.—In Barnstable County, Mass., practically all the physicians were visited in an effort to obtain data on tuberculous and suspicious cases. From this data it was concluded that a plan should be made which would combine the following: (a) preparation of records, (b) supervised field nursing, (c) free clinics with expert medical advice, (d) accurate reports of existing conditions. In Oneida County, N. Y., a tuberculosis survey with clinics was conducted during the summer and fall of 1919. The facilities for care previous to the survey were as follows: The New York State Sanatorium at Ray Brook for the care of early cases; and the County Hospital, Rome, N. Y., for advanced cases. Utica, the largest city, had a clinic open two mornings a week, and an open air school. At the close of the survey it was found that of 467 cases, 59 patients were in sanatoria, while 408 patients were living at home. Seventy per cent of these cases were not under medical supervision. The following recommendations were made: (a) Utica be provided with an evening clinic, a supervising nurse and three assistants. (b) Rome city in Oneida county be provided with regular tuberculosis clinics and a follow-up nurse. (c) The towns in the county be provided with regular tuberculosis clinics and local public health nurses. As a result, the city made appropriations for a well-trained nurse. The county tuberculosis committee financed a Saranac Lake physician who held clinics every two weeks during the afternoon and evening. They also financed a public health nurse. An automobile was provided. The approximate cost of this survey was $8000, but it would appear to be a modest sum when it is remembered that 117 unregistered cases of tuberculosis were located for follow-up work.—*The Value of a County Tuberculosis Survey with Clinics, Bernice W. Billings, Boston M. & S. J., September 16, 1920, clxxxiii, 343.*

The Work of a Tuberculosis Department.—It is necessary that the general public should realize the uneconomical methods existing at present, under which a society compels its workers to toil, though ill and infectious, until they can toil no longer. Early medical attendance and early recognition by the profession are necessary. It should be made possible for a patient to go at once into an institution, sanatorium or hospital, if his condition necessitates it. Provision on an adequate scale must be made for the maintenance of the home while the patient is away. The family of the patient and his workmates should be examined. Periodical examinations should be made of all workers at their places of employment. When a patient recovers and is able to return to work but has to seek a new occupation which is less remunerative, the national funds should make up this loss. Many are unfit to return to the community. For these colonies must be established. In them work of all kinds must be provided, with reasonable recreation and opportunities for continuance of family life under well-defined conditions. Nothing is so disastrous to patients as the fostering of a belief that they can be of no use, and that initiative is to be

suppressed. Only by this method of segregation can we hope, with our present knowledge, to make any appreciable breach in the enormous mortality of tuberculosis. In no other disease of an infectious nature do we doubt the efficacy of isolation, and by no other disease do we suffer such a continuous drain upon the working capacity of the nation. A scientific system of town planning, cheap travelling facilities, pure food, abatement of smoke nuisances, stricter and more scientific supervision of dangerous trades, many of which are only dangerous because of the cheapness of human life,—all will benefit mankind and raise the national resisting powers against invasion by any pathogenic organisms, the tubercle bacillus included. Immediately what is wanted is to remove the great mass of infection which has established itself in our midst. —*The Work of a Tuberculosis Department, D. P. Sutherland, J State Med., June, 1920, xxviii, 185.*

Tuberculosis Clinics in Ontario County.—Under the joint auspices of the Ontario County Tuberculosis Committee and the Geneva Health Bureau a monthly tuberculosis clinic has been established in Geneva. Up to the middle of August a total of 117 patients had been examined.—*News Items, New York. M. J., October 30, 1920, cxii, 686.*

Improvements at Glen Ridge Sanatorium.—The Board of Supervisors of Schenectady, N. Y., has voted $50,000 for repairs and improvements to be made at Glen Ridge Tuberculosis Sanatorium. In addition to extensive repairs, a new pavilion is to be created, a cooling system installed, and the present administration building enlarged.—*News Items. New York M. J., October 30, 1920, cxii, 686.*

The Industrial Settlement for the Consumptive.—The reason for the establishment of village settlements for consumptives is twofold: (1) the prolongation of the life of the consumptive without increasing his infectivity; and, (2) the healthy rearing of the next generation and the production in its members of increased resistance to disease. These objects cannot be attained by the mere provision of workshops for consumptives near towns, even if the labor is subsidized. For, such a plan, ignoring the adverse conditions of the infected workers' home life, would conduce neither to the arrest of the disease nor the prevention of the spread of infection. The village settlement can provide decent conditions for the families of consumptives, and, on the other hand, a hospital for the most advanced cases. The complete success of such a provision for the advanced cases is assured. The hope of the consumptive in such a hospital is encouraged to the end, and the chances of getting better are always before his mind. Not necessarily side by side, but under specially defined conditions, all stages of tuberculosis can be accommodated on the same estate. This simplifies the machinery of running the various institutions necessary, and also the running of the industrial settlement. Village settlements, when formed, will differ in many ways. The industries cannot always be the same, and the types of inhabitants will differ in different areas. No hard and fast plan can be outlined. The essential principles must be grasped and followed.—*The Industrial Settlement for the Consumptive, P. C. Varrier-Jones, and G. S. Woodhead, Lancet, May 8, 1920, cxcviii, 1041.*

A Trade Organization Sanatorium.—"Natsopa" is the name given the sanatorium recently opened at Wellsborough, Leicestershire, England, by the National Society of Operative Printers and Assistants. It is an instance of a trade organization voluntarily shouldering its own responsibility for the health of its members. It is not merely a sanatorium, but a factory as well, where convalescents are encouraged to work at their own trade for such periods as the physician allows. The psychological effect of thus getting back to skilled employment under favorable conditions can hardly be overestimated. The need for aftercare following sanatorium treatment is everywhere being acknowledged. In the plan adopted by the printers' sanatorium the psychology of industrial convalescence is recognized from two points of view: first, with regard to the influence exerted by occupation instead of idleness; and, secondly, by that occupation being useful and of the kind to be followed when health is regained—*Tuberculosis. Editorial, Lancet, June 26, 1920, cxcviii, 1379.*

Vital Capacity in Pulmonary Tuberculosis.—The authors in 1919 published a paper showing that definite relations existed between vital capacity and body surface, body weight, trunk length and chest circumference which can be expressed in definite mathematical formulae. The methods and formulae described were used in a study of vital capacity in 200 patients with pulmonary tuberculosis. It was found that in these cases there is a definite decrease in vital capacity as compared with what should be normal for the individual. An improve-

ment in the clinical condition is accompanied by an increased vital capacity; an advance of the disease, by a decrease. This, therefore, gives a valuable quantitative measure of the benefit, if any, resulting from treatment. The determination of vital capacity is useful for the classification of cases of pulmonary tuberculosis, because it is possible in this way to express numerically the injury to health (degree of toxemia), which otherwise would depend on the interpretation of physical signs by different observers. As an aid to diagnosis, a single or repeated examination of the vital capacity of doubtful cases will also prove useful. With a normal vital capacity, it is most unlikely that the patient is suffering from pulmonary tuberculosis. If the vital capacity is much decreased, the patient should be regarded as a suspect, always remembering that other diseases may also lower the vital capacity. Finally a systematic study of the vital capacity in its proper relationship to body size has given important information as to the beneficial effects of different treatments and has made it possible to distinguish quantitatively the degrees of improvement.—*The Vital Capacity Contents Applied to the Study of Pulmonary Tuberculosis, G. Dreyer and L. S. T. Burrell, Lancet, June 5, 1920, cxcviii,* 1212.

A New Method for the Interpretation of Subfebrile Temperatures in Pulmonary Tuberculosis.—Some patients, particularly those of the "nervous" type, run persistent subfebrile temperatures not warranted by the slight extent of their disease. In order to bring light into this vexing phenomenon the following experimentation was carried out on subfebrile patients. They were kept in bed from four to five days, and during this time their mouth and rectal temperatures were taken (synchronously) every two hours from 7 a.m. to 7 p.m. The second and fourth day pyramidon tablets were given them as follows: 0.3 gram at 5 a.m.; 0.1 gram hourly from 7 a.m. to 6 p.m. (total 1.5 gram). Ten of these patients, with serious destructive changes in their lungs, reacted to pyramidon. The twelve others, with very little disease (bronchial gland tuberculosis, slight fibrous changes, tubercle bacilli always absent) were not influenced by pyramidon. The test was furthermore carried out on four nontuberculous wounded soldiers with normal temperatures, and on two advanced cases of tuberculosis, also with normal temperatures. They were all uninfluenced by pyramidon. The author has so far tested his method on 60 subfebrile cases, and always with the same result. He comes to the conclusion that that temperature is a patient's normal temperature, which cannot be reduced by high doses of antipyretics. Subnormal temperatures are not considered here.—*Über eine neue Methode zur Beurteilung subfebriler Temperaturkurven im Verlaufe der Lungenberkulose, J. Hollo, Brauer's Beitr., z. Klin. d. Tuberk., August, 1916, xxxvi, 29.*

Complement Fixation.—The work reported covers 635 tests on 570 patients, fresh serum being used in every case. Antigens were made from living, virulent tubercle bacilli, ground up with sodium chloride. The results with various tubercle bacillus antigens show that in far advanced cases the greatest number of fixations were obtained with the antigen prepared by the author and with Petroff's methyl alcohol extract, both giving 70 per cent fixation. The sodium hydrate extract gave better fixation than Miller's antigen. In the moderately advanced cases the methyl alcohol preparation gave the best fixation (70 per cent); Miller's antigen gave 46 per cent and the sodium hydrate extract 45 per cent of fixations. Antigens from living, virulent, bovine tubercle bacilli according to the author's formula gave a high percentage of fixation, 52 per cent in 90 cases, while avirulent strains of tubercle bacilli showed a low percentage. Antigens from 6 strains of tubercle bacilli gave the highest percentage of fixation in the moderately advanced cases (82 per cent). The phenomenon is not a specific antigen-antibody combination but tends toward a group reaction. Next to the tubercle bacillus the other acid-fast organisms such as the smegma, the leprosy and Moeller's grass bacillus gave the higher degree of fixations. The Hecht-Weinberg-Gradwohl system when used with tubercle bacillus antigens gave a lower degree of fixation than the Wassermann test. Antigens prepared from the tubercle bacillus have a high anticomplementary titre and the close relation between the anticomplementary value and the antigenic dose causes difficulty. The sodium hydrate and methyl alcohol extractions of tubercle bacilli give high percentages of fixation, but both are prone to become anticomplementary, and the sodium hydrate preparation frequently has hemolytic properties. The emulsions of living virulent organisms give the best results if they are freshly prepared. Sufficient work has been done to show that a circulating antibody is present in the blood of a good percentage of tuberculous patients, although some do not show fixation with any antibody so far tested. The complement fixation test is not decisive, but a valuable adjunct in diagnosis.—*Complement Fixation in Tuberculosis, J. B. Rogers, J. Infect. Dis., August, 1920, xxvii, 101.*

Vitón's Tuberculin Test and Treatment. The "Argentine method" of giving extremely minute doses of tuberculin has been repeatedly mentioned in American literature. Vitón insists that in applying the tuberculin test it is as important to avoid just as carefully an appreciable local reaction as a general febrile reaction, as both do serious damage. The optimal dose has to be determined tentatively for each individual. It is that which produces decided improvement in the focus, not an aggravation. This decided improvement in the focus and in the general condition is maintained by continuing the optimal dose until its effect is exhausted, and then increasing the dose a little. As statistics show that nearly every one of us is tuberculous, this infection must be a factor in many affections in which hitherto tuberculosis has not been incriminated. By this method of tuberculin treatment in extremely minute doses, this factor is eliminated more or less completely, and the system is then able to throw off the whole affection. Dilutions of the tuberculin from 1:100,000,000 to the figure with fifteen zeros are what he uses in the subacute and chronic rheumatism of Poncet, neuralgias, dorsal myalgias, disordered heart action, arhythmia and functional disturbances of various kinds without much impairment of the general health, and in all cases of mild impregnation with tuberculous toxins with little if any derangement of the metabolism. This is the "tolerant group" of patients. The "sensitive group" includes external glandular processes, paratuberculous dyspepsia, endocrine derangement (exophthalmic goitre, hyperthyroidism, ovarian disturbances, etc.), diabetes, neuritis, and lesions of the eyes. In this group he uses dilutions of the tuberculin with from fifteen to twenty zeros. The third group embraces asthma, tuberculous nephritis, mild tuberculous toxemia, and incipient apical disease. This group is treated with dilutions of from twenty-one to twenty-six zeros. The fourth group, the "hypersensitive," includes frankly febrile lesions and softening and cavity formation in the lungs. In this group he uses the tuberculin diluted to twenty-seven zeros. With these minute doses of tuberculin the organism is helped at once and not damaged at first before help is applied, as is the case with ordinary tuberculin treatment. He advises a tentative course of the kind in every pathologic condition which, contrary to expectation, shows no tendency to recovery under persevering classical treatment. Also in every slow chronic syndrome of whatever nature, and every pathologic condition for which no definite cause can be discovered. He has had great success in tuberculous affections of the eyes rebellious to all other measures, including tuberculin by the ordinary excessive dosage. It does not conflict with other treatment, and systematic pr[illegible] schools and [illegible] the predisposition to phthisis and thus ward it off.—*La prueba diagnostico terapéutica a la tuberculina y el metodo de las muy pequeñas dosis en tuberculino-terapia (prueba y método del autor)*, *J. J. Vitón*, *Seman. Méd.*, *April 22, 1920*, *xxvii*, 545.

Three Methods of Sputum Examination. At the laboratory of the United States Health Service Hospital No. 26, Greenville, S. C., 50 to 100 specimens of sputum are examined daily. The methods tested were: (1) direct smear examination, (2) the antiformin method, (3) the autoclave method. Direct smears were made by selecting the purulent particles for examination. With the antiformin method the reagent of 30 per cent strength was added to the sputum in centrifuge tubes, the volume of each being equal, and allowed to stand from ten to twelve hours, then centrifugated at a high rate of speed. Smears were made from the sediment. With the autoclave method thick smears were prepared from the coagulum obtained by subjecting the sputum to 15 pounds of steam pressure for fifteen minutes in an autoclave. All prepared smears were fixed by heat, stained with steaming carbol fuchsin, decolorized with acid alcohol and counterstained with a saturated alcoholic solution of picric acid. Gaffky's scheme for tabulating the average number of bacteria per field was used. The concentration of bacilli is slightly larger with the antiformin than with the autoclave method. Neither surpass the direct smear examination to any extent. Of 153 examinations by the direct method 3 were negative. Of a total of 170 by the antiformin method 8 were negative. Of a total of 170 by the autoclave method only 2 were negative. The autoclave method kills all tubercle bacilli. The material subsequently is safe and easy to handle. Where large numbers of specimens are to be examined this method is most convenient.—*A Comparison of Three Methods of Examining Sputa for B. Tuberculosis*, *L. R. Jones*, *J. Lab. & Clin. Med.*, *October, 1920*, *vi*, *1*.

Viability of Acid-Fast Bacilli.—In July, 1914, a batch of stock laboratory cultures of tubercle bacilli was placed in the ice chest of the City of London Hospital for Diseases of the Chest. War broke out, and the cultures were left untouched for nearly six

years. During most of the time the chest was not replenished with ice. The culture tubes were capped with rubber. In the spring of 1920 the cultures were examined again, with the following results: One stock culture of tubercle bacillus on Dorset's egg medium survived untouched for nearly six years, while two glycerin agar cultures had died out. The living culture was of feeble virulence, and owing to this fact it was not possible definitely to decide as to the type; but the lesions produced in a rabbit exclude the human type. There is no record of the culture's virulence previous to the war. A culture of B. phlei remained alive for four years and was still strongly acid-fast, while a culture of Rabinowitsch's bacillus of the same age was found to have died out, and to have lost to a great extent its acid-fast properties. In each case the Dorset's egg medium culture was the living one. The dead agar cultures were characterized by marked pleomorphism and considerable loss of acid-fast properties.—*A Note on the Viability of Acid-Fast Bacilli, S. R. Gloyne, Tubercle, October, 1920, ii, 12.*

Symbiotic Growth of B. Proteus and B. Tuberculosis.—In a series of experiments prior to 1914, the author noted that in cultures of B. tuberculosis, grown in symbiosis with B. proteus, a diphtheroid organism appeared, when every precaution was taken against contamination. The evolution of this organism was not constant, but in 97 experiments with tubercle bacilli under different conditions, 62 per cent were positive. The most favorable conditions seemed to be glycerine-veal-brain-agar cultures of tubercle bacilli, to which 5 per cent glycerine-peptone water was added to cover the growth, inoculated with B. proteus, at a temperature of 37°C. In all cultures of this kind the diphtheroid organism was observed, usually appearing in about ten days. A marked yeast-like odor was noted, and the B. proteus culture died out. Morphologically and culturally the diphtheroid organism was identical with the acne bacillus. A second more recent series of experiments confirmed these findings, the diphtheroid organism appearing in seven to fourteen days in all cultures grown by the same method. It is premature to draw any definite conclusions, but there is justification in assuming that the appearance of the third organism is not due to contamination, and that the experiments strengthen the theory that the acid-fast organisms and the streptothrices are closely related, and that at certain phases of their existence no sharp line of demarcation exists. —*Symbiotic Growth of B. Proteus and B. Tuberculosis; Appearance of an Acne-like Organism, E. T. Thompson, Lancet, July 24, 1920, cxcix, 186.*

Creosote and Derivatives in Tuberculosis.—Despite the extensive use of creosote and related compounds in the treatment of tuberculosis, practically no evidence exists as to the susceptibility of the tubercle bacillus to these antiseptics, or as to their influence on tuberculosis in experimental animals. A series of experiments on the bactericidal power of these compounds gave the following results: Virulent human tubercle bacilli are inhibited from growth on artificial media containing 0.01 per cent, or 1 part in 10,000 each of resorcin, thymol, paracresol, orthocresol and metacresol; 0.05 per cent (1:2,000) of creosol and pyrocatechin; 0.1 per cent (1:1000) of guaiacol, creosote, hydroquinone and guaiacol cacodylate. Sodium guaiacolate inhibited completely at 1.7 per cent, and partially at 0.8 per cent. Thiocol did not inhibit in 1 per cent concentration, and styracol not in 10 per cent concentration (suspension). Tests to determine the capacity of the tubercle bacilli to grow on agar, after exposure to the antiseptic, showed that exposure of human tubercle bacilli to even 1 per cent solutions of pyrocatechin, hydroquinone and resorcin, and 0.5 per cent of cresol, for ten minutes to forty-eight hours, fails to kill them. Metacresol and paracresol kill in 1 per cent concentrations after exposure for one hour, but not after ten minutes. Orthocresol reduces growth after one hour and kills in six hours. Thymol kills in ten minutes in 1 per cent concentration, but 0.1 concentration does not kill even in forty-eight hours. In another series of tests the tubercle bacilli were exposed to the antiseptic, when in a thin layer, and viability determined by inoculating guinea pigs with the treated bacilli. Resorcin in 1 per cent concentration killed only after twenty-four hours exposure. Orthocresol killed in 1 per cent concentration in twenty minutes, but 0.5 per cent did not kill in twenty-four hours. Creosote and guaiacol killed most of the bacilli in 0.5 per cent concentration in twenty minutes, but 0.1 per cent concentration was not bactericidal in twenty-four hours. Thymol was bactericidal in 0.1 per cent concentration in twenty minutes, but 0.01 per cent was not bactericidal in twenty-four hours. Comparing these figures with those given by De Witt and Sherman for other antiseptics, creosote, guaiacol, and the cresols have about the same low tuberculocidal power as phenol. Thymol has a slightly greater bactericidal power than the other substances tested. Therapeutic tests were made on two groups of guinea pigs, one of which was injected with a highly virulent strain of human bacilli, the other with a less virulent one. The animals received several doses of the drug by the intracardiac, intramuscular, and subcutaneous routes, and

by daily feedings of pills containing the following drugs: creosote, guaiacol, creosole, thiocol, styracol, orthocresol, metacresol, paracresol and thymol. Apparently the animals injected with the less virulent tubercle bacilli showed more active tuberculosis than the controls. With the more virulent bacilli, the extent of the disease was perhaps slightly less in the treated animals, but they died a little earlier than the controls. The experiments indicate that the bactericidal power of the creosote series is low in vivo as well as in vitro. This does not mean that they may not have value in open tuberculous infections in man in which bacteria other than the tubercle bacillus are involved, but it does substantiate the opinion of careful clinical observers that creosote and guaiacol do not have a specific action on tuberculous infection.—*The Influence of Creosote, Guaiacol, and Related Substances on the Tubercle Bacilli and on Experimental Tuberculosis, L. M. De Witt, B. Suyenaga and H. G. Wells, J. Infect. Dis., August, 1920, xxvii, 115.*

Silica as a Cause of Printers' Phthisis.—In a letter to the *Times*, Mr. E. Halford Ross brings forward a new theory as to the causation of printers' phthisis. Early in 1918 he reported to the health committee of the joint industrial council of the printing trades that there was a concentration of hereditary predisposition to consumption in compositors owing to the "closeness" of their craft and to intermarriage within their families. About a year ago his suspicions fell on printers' list as a cause. It is a black, grimy, woolly, fluffy substance that collects in compositors' boxes, trays, cases and chases. It had already been examined by bacteriologists for the tubercle bacillus but found to be sterile. This was a peculiar fact and encouraged Mr. Ross to make a further examination. He then found that the list does not readily decompose like the dirt collected in rulers,' readers' and binders' rooms, which soon becomes musty and smells. Then he remarked its weight and realized that there was no object in looking for the tubercle bacillus in it, for the bacillus was already latent in the human subject. A chemical analysis was carried out. Samples of list were obtained from various works and sent unlabeled to chemists. They reported that the list from composing rooms contained both silica and iron in appreciable quantities; the list from machine rooms contained less. It is known that silica and the oxides of iron light up phthisis when inhaled continually by those predisposed to the disease. The condition of the lung produced by silica, which predisposes to phthisis, has been described as silicosis. One of the great printing firms of London has for some time used suction bellows on compositors' trays, cases and chases to remove the list.—*London Letter, J. Am. M. Ass., November 6, 1920, lxxv, 1280.*

The Crippled Child. New Tuberculosis Methods. There is no more sorrowful sight in our modern life than the child afflicted with tuberculosis. The twisted back, the limbs swollen and contorted, the drooping head furnish so eloquent an appeal for help that the hardest heart may not resist it.

Any real progress in the treatment of such conditions deserves the widest acknowledgment. This progress is to-day a reality, as may be seen by anyone instructed in the treatment of surgical tuberculosis who visits the Lord Mayor Treloar's Home at Alton. The medical officer of this institution has devoted his life to the work. The upshot of that work may necessitate our abandoning the habit of speaking of "surgical" tuberculosis at all. For the truth would seem to be that the less surgery we employ the better the patient's chance of recovery.

It used to be urged that the surgeon should open up tuberculous disease areas in bones and joints and elsewhere. The idea was that by this means each focus of infection was dealt with and the general mass of infection was lowered. In consequence we had a very great development of what was called the surgery of tuberculosis, and indeed the name "surgical tuberculosis" was coined to differentiate these conditions from pulmonary tuberculosis or "consumption."

But a careful study, and, what is even more important, a careful following up of the cases after discharge from the home, have led to the idea that very often surgery does no good at all and that it may easily do a great deal of harm. The truth is that tissues which have been attacked by the tubercle bacillus become very weak and lose their resistance to such an extent that if any other germs reach them they fall an immediate and easy victim, and so a new infection is added to the old one. Surgery is apt to open the way for the entry of new germs. Wounds are made, they become infected, fever supervenes, and the child develops the "hectic" appearance which is associated not with tubercle itself but with a new infection superimposed on tubercle.

At Alton the methods of surgery have been largely dispensed with. Accumulations of fluid are removed, it is true, but only by aspiration, that is, by a fine hollow needle. Thus there are no wounds to become infected and the deadly "secondary infection" is avoided. The tubercle bacillus is

thus separated from its most dangerous "allies." It is then dealt with by making the human soil in which it flourishes as unsuitable as possible for its growth. Vaccines are not used as they have been found of little value. The child itself is the study. By rest, by the use of very clever and very original apparatus relieving the weak place from strain, by sunlight, by good food (but not "stuffing"), and finally, when the patient is better, by exercise and the stimulation of country surroundings the battle is won. You really play up the child against the germ, and given a decent chance the child wins. This is neither surgery nor bacteriology (though both may be employed as helps now and again); it is medicine in the best sense of that much abused word.

The work is revolutionary in its character. It owes much to the devotion with which it is being carried on and to the imagination which obtained the requisite site in Hampshire for the benefit of these suffering children.—*Editorial, N. York State J. Med., October, 1920, xx, 311.*

Destruction and Repair in Pulmonary Tuberculosis.—Variations in the clinical behavior of patients ill with active pulmonary tuberculosis are frequently indicative of their diminished resistance and the progression of their lesions. Such variations, though slight and apparently negligible, may be as important indications of progression of the disease as are similar variations of its conception. Such variations should suggest the importance of careful reëxaminations which frequently disclose retrogression of the lesion before the advent of more marked symptoms, and make possible helpful modifications of the management of the patient. Roentgen ray findings, and especially stereoscopic studies, should be employed in addition to physical examination. A few clinical and roentgenographic records are selected to illustrate these observations.—*Destruction and Repair in Pulmonary Tuberculosis, B. H. Waters, J. Am. M. Ass., October 30, 1920, lxxv, 1187.*

Progress in Nephrectomy.—This report comprises 207 nephrectomies performed at Mt. Sinai Hospital, New York City, since 1914 with a mortality of 3.8 per cent.

Renal tuberculosis forms the largest group in the series for which nephrectomy was performed: 92 cases with 2 deaths, a mortality of 2.1 per cent. There were 5 secondary nephrectomies; 3 of the operations were subcapsular. In two instances the disease was bilateral and the more diseased organ was removed. In general, the ureter was ablated as low down as possible, through the lumbar incision, phenolized and dropped back into the wound; complete excision of the ureter down to the bladder, through an anterior extraperitoneal incision, was practised ten times (approximately in 10 per cent of the cases). Its main indication is marked stricture formation at the lower end of the ureter. In a number of instances, the lumbar wound became tuberculous and broke down, weeks after the operation, whereas the anterior incision required for removing the ureter has never been so infected. The mortality following nephrectomy for tuberculosis has steadily diminished. In 1902, in the hands of well known surgeons, the fatalities numbered between 18 and 20 per cent. More recent statistics are given in the accompanying table.

Fatalities in renal tuberculosis

	Nephrectomies	*Mortality Per cent*
Frank	1,331	9.3
Legueu and Chevassu	1,539	5.9
Israel	1,023	12.9
Albarran	118	3.3
Wildbolz	139	2.8
Zuckerkandl	104	7.7
Braasch (Mayo Clinic)	532	1.3

The unquestionable value of cystoscopic and functional examinations in lowering the mortality is especially noticeable in the reduction of the death rate from uremia. Pousson, in a series of 435 nephrectomies performed a number of years ago, reported 128 deaths, 51 of which were due to renal insufficiency. This at present is one of the most infrequent causes of death. Legueu and Chevassu reported 1,539 nephrectomies, with 43 deaths, 12 of which were due to uremia. The most common causes of death following nephrectomy for tuberculosis, in order of frequency, are myocarditis, pneumonia and embolism. Tuberculous meningitis, although mentioned by some authors, is a very infrequent cause of death.—*Progress in Nephrectomy. A Study Based on a Series of 207 Cases, E. Beer and A. Hyman, J. Am. M. Ass., October 30, 1920, lxxv, 1180.*

Subcutaneous Emphysema in Acute Pulmonary Affections.—Subcutaneous emphysema in the course of acute respiratory affections is rare in adults and in itself not serious, the prognosis depending entirely upon the underlying disease. The emphysema is at first interlobar and subpleural, then mediastinal and lastly subcutaneous. When it occurs in the course of pulmonary tuberculosis, it is generally of grave significance.—*De l'emphyseme sous-cutané dans les affections pulmonaires aigues non tuberculeuses chez l'adulte, Ch. Roubier, Progr. Méd., October 9, 1920, 439.*

Knee Joint Tuberculosis in Children.—Open air, sunshine, tonics, nourishing food and congenial and at the same time sensible surroundings should be insisted on in the treatment of this condition. The keynote to local treatment is conservatism. If treatment is instituted early and the proper means are taken to prevent the development of deformities, the management is easy. The patient coming late with subluxation and knock-knee and external rotation of the tibia is, on the other hand, most difficult to treat. A properly applied plaster of Paris cast affords excellent fixation. The ordinary stiff legged brace, in mild cases, is often sufficient. In the more acute cases rest in bed with extension may be necessary and when the patient is allowed to be up, a plaster of Paris cast is indicated, with a high soled shoe on the opposite foot and crutches to prevent weight bearing. The Thomas extension splint is excellent, but unless guarded against is especially prone to cause a relaxed knee joint. As the condition improves, a walking caliper Thomas splint may be used. All apparatus must be supervised carefully and care taken once the flexion is overcome to prevent genu recurvatum. When subluxation is present, more elaborate measures are necessary. Prolonged traction with weight and pulley, with the line of pull carefully directed, may straighten the knee. At the first indication of a tendency to further subluxation, the force should be stopped and a cast applied with the flexion deformity only partially corrected. This may be repeated and usually the knee can be brought straight in three or four attempts. The knee must never be moved back and forth, but merely forced straight to the point where it seems safe. It has never been the custom in the Mayo Clinic to resect tuberculous knees in children.—*Tuberculosis of Knee Joint in Children, M. S. Henderson, Minn. Med., October, 1920, iii, 463.*

Ileus in Course of Tuberculous Peritonitis.—Aimes comments on the small number of such cases on record, ascribing this to the nonrecognition of the true cause of the ileus in many cases. In the 68 operative cases he has compiled, 23 of the patients were under 16; 45 of the 68 recovered. The immediate mortality was 55 per cent, and the total mortality within a year was 63 per cent. The death rate was only 27 per cent in the cases in which intervention was restricted to cutting adhesions binding down the bowel. If the peritonitis is healed, the entire abdominal cavity should be explored to discover adhesions. With a florid peritonitis, simple exposure to the air may cure paralytic ileus, or the feces can be manipulated through the contracted segment, or profuse irrigation with heated serum may cure. The agglutinated mass of intestines was resected in one case, the patient dying. The 3 patients treated with anastomosis all recovered. Canessa injected 10 liters of oxygen into the abdominal cavity, with the recovery of the patient. Even in apparently the most desperate cases, cautious surgical intervention may prove successful.—*L'occlusion intestinale au cours de la péritonite tuberculeuse, A. Aimes, Rev. d. Chirurg., 1920, xxxix, No. 3, 177.*

The Dissemination of Tuberculosis Among Cattle.—Statistics of the number and percentage of cattle reacting to tuberculin and of those showing tuberculosis upon meat inspection are given for Belgium, Great Britain, France, Italy, Pyrenese Peninsula, Balkan Peninsula, Russia, Finland, Asia, Australia, North America, Central and South America, and Africa. Tuberculosis is disseminated among the cattle of all civilized countries. It is the most widely disseminated cattle disease. Its occurrence is intimately related to the development of intensive agriculture and the problem of a natural comfortable mode of life. That the keeping of cattle in stalls favors the development of tuberculosis is seen from the experiences of the white cattle of the steppes. As long as these remained on the steppes they developed no tuberculosis, but when placed for one-half year before slaughter with the cattle of the cultivated breeds in stalls, they became victims of tuberculosis. On the other hand when set free upon the pastures an arrest of the disease takes place as happened in America. Frequent change from land to land predisposes to tuberculosis. Among the cattle of the American prairie, the Bukowinian cattle and those of the Polar regions, the north of Sweden and Norway, those of Algeria, Arabia, North Africa, the Russian steppes, Iceland, Sardinia, Sicily and Japan, tuberculosis is only occasionally seen, if seen at all. On the other hand, in western Europe, in the thickly populated areas, in the vicinity of the large cities and the larger agricultural areas where milk is intensively produced, tuberculosis is widely disseminated among the cattle and is found to be steadily increasing. The inferior breeds are infected to a greater extent than the selected breeds. However one cannot speak of a racial (breed) immunity among cattle inasmuch as living conditions will often render the nonsusceptible susceptible to tuberculosis. Liability to infection of course plays the dominant part in the occurrence of the disease, and incidence

of infection increases with the years of life. More than half of the tuberculosis in cattle occurs after the sixth year. The cow becomes tuberculous more often than the bull. This is due probably to the weakening influence of milk production and reproduction. Feeding influences the morbidity. Feeding of the byproducts from distilleries, breweries, sugar refineries, etc., has a weakening effect and hence favors the development of tuberculosis. In the neighborhood of foundries, cattle are exposed to respiratory diseases and indirectly to tuberculosis. Climatic conditions favoring the catching of colds predispose to it, as well as sudden changes to a different environment and a different mode of life.—*Die Verbreitung der Tuberkulose unter den Rindern*, *W. Seifert*, *Zeitchr. f. Tuberk.*, *August*, *1920*, *xxxii*, *283*.

Prophylactic Vaccination of Cattle against Tuberculosis.—When bovine tubercle bacilli are cultivated on glycerine-bile media in long successive series, a race of attenuated bacilli is obtained, which have become avirulent for cattle, monkeys and guinea pigs. They can be injected in considerable doses intravenously without producing tuberculous lesions, but they confer, commencing the thirtieth day after inoculation, a durable resistance against intravenous test inoculations. The tolerance of the animals against this avirulent strain also manifests itself in the fact that they remain well when they are placed in close contact with tuberculous cows in infected stables. This protection from one single vaccination lasts eighteen months, but can be maintained indefinitely by yearly revaccinations which are in themselves harmless. The authors recommend that their method be tested out on a large number of animals over a period of years corresponding to the average duration of life of these animals.—*Nouvelles recherches expérimentales sur la vaccination des bovidés contre la tuberculose*, *A. Calmette and C. Guérin*, *Ann. de l'Inst. Pasteur*, *September*, *1920*, *xxxiv*, *37*.

Camphor in Hemoptysis.—Hemoptyses are of two kinds: (1) those due to a damming up of the blood, and (2) those due to the rupture of a vessel. In the first, the bleeding comes on slowly and with little froth. The blood is usually dark brown. The cause is a circulatory insufficiency of cardiac or vasomotor origin. In the second, the bleeding comes on rapidly and with much froth. The blood is usually red. Camphor is small doses stimulates the heart and mildly the vasomotor centre. The pulse volume is increased and there is a larger variation between systolic and diastolic pressure. This insures a better flow of blood through the lungs. In large doses camphor causes a dilatation of the peripheral vessels with an increased blood supply and by its action on the vasoconstrictor centre causes constriction at the seat of injury, thereby inviting local thrombosis. Aside from its principal mechanical action camphor secondarily produces an increase in the thrombokinase flowing to the part.—*Lungenblutung und Kampferwirkung*, *K. Lehner*, *Zeitchr. f. Tuberk.*, *August*, *1920*, *xxxii*, *276*.

How to Arrest the Disease and Avoid Invalidism.—The total percentage of the tuberculous who secure an arrest or healing of their disease, whether treated in the home, the dispensary or the sanatorium, is disappointingly small. Of those who are pronounced arrested or healed the number who relapse is large. Of those who remain well as far as their tuberculous infection is concerned, a large number are in a state of invalidism. Tubercles undergo much the same type of evolution that is noted in a boil, that is, implantation followed by induration, necrosis, rupture and healing, but the changes take weeks, months or years instead of a few days. The fact that practically all patients who manifest their clinical symptoms in adult life have been in stages alternating between activity and arrest, should suggest the possibility of healing in a large proportion of early clinical cases. Sanatoria and dispensaries are filled with advanced cases. Specialists are spending most of their energy fighting a losing fight with patients far advanced in the disease. The tuberculous man must not be permitted to become a consumptive. Most laymen and many medical men do not realize that months, at times years, intervene between different periods of activity. If active disease does not follow at once they often assume that the diagnosis was in error. Hygienic working colonies should be provided for the patients with arrested disease who are financially dependent. The length of time required for the pathological process to heal is far longer than is usually believed. In early cases it may take two years or more. Relapses usually occur three to nine months after the patient leaves off treatment. Pottenger treats his patients until physical exercise such as walking from one to ten miles produces no toxic symptoms. The patient is then allowed to interrupt treatment for three to nine months with only occasional supervision. He then returns for another period of strict guidance. In far advanced cases a second period of rest is followed by a third period of strict guidance. To prevent invalidism patients must

be told what they can do, not what they cannot do. The patient's nervous and psychical equilibrium, and his physical vigor and resistance must be restored before he is discharged.—*How May the Tuberculous Patient Secure an Arrestment and Avoid Becoming an Invalid? F. M. Pottenger, N. York M. J., September 18, 1920, cxii, 389.*

The Determination of the State of Immunity in Prognosis and Treatment. —When centrifugalized blood serum is carefully added to a 10 per cent solution of tuberculin in physiological saline solution containing 0.5 per cent phenol, a precipitate or clouding may or may not take place at the junction of the two liquids. The reaction is tested in small pipettes and 0.5 cc. of each fluid is used. Care must of course be taken not to mix the two fluids. After incubation at 37°C. for twenty-four hours the reaction is studied and one of the following phenomena is noted at the junction of the two liquids: (1) A thick disk-like precipitate. (2) A flocculent ring-like clouding or a suspended focculent precipitate. (3) A slight clouding or translucency. (4) No change. Number 1 is termed a strongly positive or two plus reaction; 2 a slightly positive or one plus; 3 a questionable or plus minus; and 4 a negative reaction. The reaction is termed *immunity reaction (I. R.)*. The substance causing the reaction is probably analogous to the precipitins or to the alexins. In the same individual the reaction usually remains the same under ordinary circumstances. The lack or presence of the protective substance is inherited. Its lack means a susceptibility to tuberculosis or tuberculous intoxication and is the cause of inherited or acquired tuberculous predisposition. In pregnancy and acute infectious diseases (pertussis, measles) the protective substance is inhibited. Malaria, chronic Bright's disease and pneumonia give a two plus reaction. Lues gave a two plus reaction with but one exception. In three cases of psoriasis the reaction was weaker than usual. In severe anemias there was a sudden drop in the intensity of the reaction. The *prognostic index (P)* is determined from the *Immune Reaction (I. R.)*, the cutaneous tuberculin or *Sensibility Reaction (S. R.)*, the presence or absence of tubercle bacilli, and the physical findings. From these factors a table of nine indices is made as follows:

SERUM REACTION (I.R.)	CUTANEOUS SENSITIVENESS (S.R.)	TUBERCLE BACILLI, CLINICAL FINDINGS	PROGNOSTIC INDEX	QUALIFICATION OF THE CASE	PROGNOSIS
++	0	0	1	Nontuberculous with good resistance	Not susceptible to tuberculosis
+	0	0	2	Nontuberculous with weak resistance	Some susceptibility to tuberculosis
±	0	0	3	Nontuberculous with very weak resistance	Susceptibility to tuberculosis
−	0	0	4	Nontuberculous with no resistance	Great susceptibility to tuberculosis
++	+	− or +	5	Tuberculous with good resistance	Tendency to spontaneous healing. Process not progressive. Retrogression likely
+	+	− or +	6	Tuberculous with weak resistance	Some tendency to spontaneous healing. Process not progressive. Retrogression doubtful
±	+	+ or −	7	Tuberculous with very weak resistance	Poor tendency to spontaneous healing. Process progressive. Retrogression not looked for
−	+	+ or −	8	Tuberculous with no resistance	No tendency to spontaneous healing. Process progressive
0	0	0	9	Tuberculous with no reaction and resistance	Spontaneous or artificial immunization out of question. Body does not react. Process progressive

Those with indices 1, 2, 3, 4 may be looked upon as not having tuberculosis but their future liability to the disease is less the stronger their prognostic index and the stronger their immune reaction. In order to increase the immunity reaction emulsions of dead tubercle bacilli are given subcutaneously, intramuscularly or intracutaneously according to certain indications derived from the patient's condition, The Hollaender-Richter tuberculosis vaccine (*H. R. V.*) is the preparation employed, a description of which is given. Those with indices 1 and 5 need no immunization. Those with index 9 should not be given the vaccine, for the body apparently is overwhelmed by the intoxication. The vaccine (per cc.) is employed in the following dilutions:

1. =	1 mgm.	6. =	$\frac{1}{32}$ mgm.
2. =	$\frac{1}{2}$ mgm.	7. =	$\frac{1}{64}$ mgm.
3. =	$\frac{1}{4}$ mgm.	8. =	$\frac{1}{128}$ mgm.
4. =	$\frac{1}{8}$ mgm.	9. =	$\frac{1}{256}$ mgm.
5. =	$\frac{1}{16}$ mgm.	10. =	$\frac{1}{512}$ mgm.

Those with indices 2 or 6 are treated with strength 10.

Those with indices 3 or 7 are treated with strength 9.

Those with indices 4 or 8 are treated with strength 8.

The amount of vaccine given is determined by the body weight, which, figured in kilograms and divided by 100, will give the first dose expressed in cubic centimeters. Thus a man of 58 kg. will receive in volume 0.58 cc. From the local reactions graded into four stages the subsequent doses are determined. Stage 1 (−) is accompanied by no symptoms; 2 (+) has a transient local swelling, disappearing before the next injection; 3 (++) has a lasting, hard, nodular infiltration; 4 (+++) has local necrosis, destruction of tissue and pustulation. With a one minus local reaction the dose is increased, with a one plus the dose is repeated, with a two plus the dose is reduced and with a three plus reaction no further injection is given for six months when the prognostic index is redetermined. The second injection is given two weeks after the first, the third three weeks after the second, the fourth four weeks after the third, etc. Injections are continued until the *immune reaction* (*I. R.*) is two minus as in prognostic indices 1 and 5. Immunization must not be considered in a clinical sense. The physical findings, including tubercle bacilli and temperature, may show no change, but the power to withstand the disease may have been recovered. The vaccine is contraindicated in (1) those with a prognostic index of 1, 5 or 9; (2) those with a daily maximum of 100.2° F.; (3) infiltrative-pneumonic types (Fraenkel-Albrecht classification), that is, with cavity formation, septic-pyemic symptoms, high fever, profuse hemoptysis,. cachexia and laryngeal or intestinal tuberculous complications, and (4) hematogenous, disseminated tuberculosis and tuberculous meningitis.

Summary: Three new things have been presented. (1) "Immunity reaction" and "prognostic index." (2) A method of therapeutic and prophylactic immunization. (3) The substance or vaccine to be used. Statistical evidence is not furnished here but will probably be furnished later. The *H. R. V.* preparations may be obtained for experimental purposes from the Budapest Jenner-Pasteur Institute.—*Die Feststellung der Immunisierung zur Vorbeügung und Behandlung der Tuberkulose, H. Hollaender, Zeitschr. f. Tuberk, August, 1920, xxxii, 257.*

Training of the Tuberculous. The subject of the tuberculous sufferer is a complex one. There is ample room for experiments. Patients who are under twenty-two years of age, and whose occupation is of a kind known to have a high mortality rate from tuberculosis should change their occupation. A "light place in the country" so often advised by the tuberculosis officer is practically nonexistent. Agricultural work is highly skilled and extremely arduous, With arrested disease patients over twenty-two should be advised to go on with their occupation when the latter is definite and lucrative. The large class of those who improve, but can never be pronounced arrested, are only fit to work under restrictions. The discharged tuberculous soldier does not want to work. Sanatoria should be urged to employ ex-patients in every possible capacity. Cabinet making, watch and clock repairing and cleaning, boot repairing, toy and jewelry making and the management of village shops are suitable occupations for the male consumptive, as they allow him to be his own mas er and to work when he is able. Dress making, lace making, embroidery and domestic work are suitable for the women. Some advanced cases can do a certain amount of work, namely the usual work of the institution and the simpler part of the particular industry in which the sanatorium is engaged.—*The Training of the Tuberculous Sufferer, J. H. Walker, J. State Med., June, 1920, xxviii, 185.*

Occupational Therapy.—The chief aim of occupational therapy is its psychic effect. It is applicable to all stages of tuberculosis. It diverts and hardens. It stimulates the appetite and induces a healthy frame of

mind. To this psychic benefit is added the important function of the production of specific poisons by autoinoculation, as soon as controlled exercise is included in the regimen. The activities of the Boston Consumptives' Hospital are religious, diversional and occupational. There are newspapers, magazines, a circulating library, moving pictures, checkers, chess and cards. Tobacco in moderation is permitted. Ambulatory patients are engaged in reed and raffia work, basketry, weaving, bookbinding, jewelry, chair caning and crochet work. Eleven patients with positive sputum, four of whom had cavities, were employed as orderlies. All of them improved, most of them gained in weight. Remuneration of the patients' work is an important factor in keeping them interested.—*Occupational Therapy for the Tuberculous, F. H. Hunt, Boston M. and S. J., September 16, 1920, clxxxiii, 356.*

The Lungs under the Influence of Artificial Pneumothorax.—One of the chief objects of this article was to see whether artificial pneumothorax could be employed on incipient cases. As a result of his experiments Tomaczewski found: (1) The compression of the lung succeeds better with the rabbit than with the dog. (2) As a rule, it is not uniform, inasmuch as in the majority of cases the upper lobe is most strongly compressed (3) Under its influence changes of inflammatory character develop in the lung: small-celled infiltrations develop pretty early around the blood vessels and bronchi, which in the later stages assume the character of granulation tissue; in the dog they appear in smaller number. In the pleura thickenings develop which in early stages consist of granulation tissue and later of striped connective tissue penetrating into the parenchyma of the lung. These changes are much more pronounced in the dog than in the rabbit, and in like measure affect all the lobes of the lung of the compressed side. The blood content of the compressed lung is small, and the lymph vessels are dilated. The changes in the parenchyma of the lung are probably chiefly of pleuritic origin. (4) In the noncompressed lung no changes are found except hyperemia and vicarious emphysema. Artificial pneumothorax in rabbits does not alter the favorable conditions for the development of the infection, when tubercle bacilli are injected intravenously. Since we never know with certainty which form of tuberculosis is mild, and whether a case will be arrested or cured by dietetic and general measures alone, it seems that cautious attempts to treat incipient stages with pneumothorax are completely justifiable.—*Histologische Veränderungen der normalen und mit Tuberkulose infizierten Lunge unter dem Einfluss des künstlichen Pneumothorax, L. Tomaczewski, Beitr. z. Klin. d. Tuberk., August, 1916, xxxvi, 1.*

Results of Pneumothorax Treatment.—Since December, 1906, 430 patients were treated at the Vejlefjord Sanatorium, Denmark, with about 10,000 insufflations in all. Except two cases of sudden death in 1910 and 1912 there have been no accidents from the induction of the pneumothorax. After-histories of patients discharged from 1907 to 1916 show that in 275 collapse treatment had been tried. Six of these were nontuberculous. All but 2 were in the third stage of tuberculosis and had positive sputum. In 85 cases efficient pneumothorax treatment could not be obtained because of technical difficulties. These are the controls. Of the technically effective cases, after three years, more than 40 per cent, and after seven years, 32 per cent were still able to work. The parallel numbers of the control cases were 21 and 16 per cent. Cessation of a pneumothorax is always a risk. When the cases are well, injections of gas every second or third month will be sufficient. The treatment is continued for about five years. If all is then normal, the lung is allowed to expand, the patient being observed very closely for the first few months. Injection of gas is renewed if symptoms of relapse appear, which is rare. The best results were obtained by a combination of pneumothorax with strict sanatorium treatment.—*The Results of Pneumothorax Treatment of Pulmonary Tuberculosis, C. Saugman, Lancet, October 2, 1920, cxcix, 685.*

Pleural Obliteration Complicating Pneumothorax.—Contraction of the pleural cavity down to obliteration following effusion is an unfavorable termination of artificial pneumothorax. It is illustrated by the following case: A barber, aged seventeen, in the third stage of tuberculosis, received left-sided N insufflations from June, 1915, on. The temperature became normal in a month and the sputum very much diminished in quantity. In August the temperature rose to 101° and a small left serous effusion was found. At the succeeding refill 390 cc. of N changed a mean pressure of −11 to one of +3.5, whereas formerly it took 520 cc. to convert −9 into +3. In September the patient began to get up and take exercise. The condition remained excellent until October 16 when another small serous effusion was found. On October 23 positive pressure was discovered although no refill has been given for a fortnight, when the mean pressure had been left at −2.5. The

whole left pleural cavity was contracting, and by February, 1916, moist sounds were audible over the left upper lobe. The temperature rose and all dilating efforts failed. Extrapleural thoracoplasty was performed July, 1916. The patient died during the operation, which was in all probability due to the general anesthesia. The etiology of this complication is concerned with that of effusions in general, which, aside from sepsis, are due primarily to the tubercle bacillus. The most generally invoked contributory cause is exposure to cold. Thoracentesis and replacement of the fluid with gas or air are useless in the long run. Extrapleural thoracoplasty is necessary to maintain lung collapse. It should be performed under local anesthesia.—*Pleural Obliteration: A Complication of Artificial Pneumothorax, W. C. Rivers, Lancet, July 31, 1920, cxcix, 244.*

X-ray an Essential Guide for Pneumothorax.—Before pneumothorax is produced the following points should be studied: (1) The extent of the lesions, especially as to cavities. (2) Will the opposite lung be able to furnish sufficient pulmonary tissue after the affected lung has been collapsed? In unilateral cases there is no question of the advisability of the treatment. In advanced bilateral cases the patient is probably going to die. The cessation of cough, control of hemorrhages and lessening of toxemia outweigh the risk taken in throwing an additional burden on the small amount of uninvolved lung tissue remaining. (3) Adhesions and fibrinous pleurisy must be considered, as a lung firmly adherent to the parietal pleura cannot be collapsed. If these bands are not too strong, their gradual tearing loose can be watched by the X-ray as the treatments are continued. In the last three months 453 X-ray examinations were performed at the United States Army General Hospital, Ft. Bayard, N. M. Three cases are cited which had been given up as hopeless. Two of them were bedridden for almost a year; after repeated injections of air they have become able to walk about the hospital grounds to a limited extent. A patient who was discharged in 1914 with artificial pneumothorax on one side, and an inactive tuberculosis in the other lung returned in May, 1920, after having worked constantly without any other bad result than the collection of about 2000 cc. of fluid in the chest. The possibility of acceleration of the tuberculous process in the opposite lung must not be forgotten.—*The X-ray as an Essential Guide for Producing Artificial Pneumothorax in Advanced Clases of Pulmonary Tuberculosis, D. D. Krupp, N. York M. J. October 30, 1920, cxii, 18.*

Roentgen Ray Treatment of Surgical Tuberculosis.—Iselin analyzes the experiences at Basel, 1907–1914, with 1133 cases. They confirm the possibilities of conservative treatment, especially the extraordinarily favorable prognosis under roentgen ray treatment. It is useful as an adjuvant to operative measures. Iselin is a surgeon, not a radiologist, but he regards well planned roentgen ray treatment as a fine foundation for conservative treatment. Old tuberculous processes yield earlier and more completely to the rays than young and active ones. The efficacy of the rays is seen particularly in the disappearance of tuberculous lesions in glands, omentum, soft parts and joints, of many years' standing, and by the reduction of the virulence of the pus from abscesses in experimental lesions. The ambulatory treatment and the noninterference with the earning capacity compensate for the length of the course.—*Röntgenbehandlung der chirurgischen Tuberkulose, H. Iselin, Schweiz. med. Wchnschr., June 17, 1920, lx, 499*

Appliance for Simultaneous Irrigation and Radiation.—Pus, mucus and cellular debris in wounds interfere with the penetration of the ultraviolet rays and therefore hinder their healing effects. Accordingly, an applicator is devised to cleanse the areas to be radiated and simultaneously to apply the rays. Five types of quartz applicators are shown, differing only slightly in construction and all easily attachable to the Kromäyer lamp. The rays are reflected by the walls of quartz, as well as by the surface of the water, so that no interference to their passage occurs. The flow can be regulated by pressure on the rubber tube leading to the applicator. An inverted mirror made of platinum-iridium can be used to increase the total reflection. The applicator is very useful in treating abscess cavities of any sort, fistulae, and uterine and vaginal affections.—*Der Quartzspüler. Ein neues Prinzip in der Ultraviolettbehandlung, H. Ladebeck, Deutsche med. Wchnschr., September 16, 1920, 1055.*

Treatment with Monochromatic Light.—In view of the varying behavior of the rays in different parts of the spectrum, attempts were made to construct monochromatic lights with maximum amounts of energy. Two were made; the one liberating rays extending from the yellow far into the ultrared with the maximum energy in the ultrareds, and the other consisting of only the red and yellow rays. The first liberates a reddish-yellow light with great heat; the second, called a Neon lamp, emits a cold,

bright red light. The author has employed these lights since 1914 upon hundreds of patients. The Neon light has a sedative action and causes inflammations to disappear rapidly; edema and swellings vanish; secretions dry up; pus is diminished, and itching and paresthesiae are controlled. Rheumatic conditions are well suited for treatment; here pain is quickly lost. The technic is simple. The diseased area is exposed for twenty minutes to one hour as near to the lamp as possible. In cutaneous affections bandages should be worn between exposures to avoid the irritating effect of the daylight. —*Uber monochromatische Lichtbehandlung, F. Nagelschmidt, Berl. klin. Wchnschr. August 16*, 1920, *783*.

A New Neon Lamp. The advantages of this new lamp are that it carries an exceptionally strong current and is very practically constructed for local lesions, such as wounds and circumscribed skin diseases. It can even be placed directly into a wound. This is possible because of its aseptic construction. It emits an intense yellow light in wave lengths from 740 to 580 microns.—*Eine neue Neon Lampe, Axmann, Deutsche med. Wchnschr., September 16, 1920, 1056.*

Effect of Ultraviolet Therapy upon Metabolism.—Patients, who show a urea nitrogen that is one-half that of the total nitrogen reveal, after several months' exposures to the mercury-quartz light, an increase of 30 per cent in the urea nitrogen. Diabetics show increased oxidation, having as much as 85 per cent urea nitrogen; and therefore should not be treated with ultraviolet exposures until there is a more normal chemical balance. The blood sugar, as well as the urine, must first be normal. Ultraviolet rays have an important therapeutic value. Before applying them the writer studies the blood chemistry of his patients, as well as the urinary, blood, blood-pressure and heart efficiency. Cellular protoplasm absorbs the ultraviolet rays. Exposures properly graded give the changes of sunburn. An overdose of the rays produces fatigue, exhaustion, low blood pressure, chilliness and symptoms of shock. It is necessary to know the exact strength of the quartz burner, its distance from the patient, the time of exposure and the patient's reacting power. Radiating the spinal area will especially help the muscles, secretions and organs supplied by the sympathetic nervous system.—*Quartz Ultraviolet Therapy and Kinetic Energy, D. McCaskey, N. York M. J., December 27, 1919, cx, 1058.*

Codliver Oil in Tuberculosis.—Oldtime medical men believed and preached that codliver oil was a cure for consumption, and this view was held for many years, in fact, until what may be termed the modern school of bacteriologists arose. Those of this school, who made a special study of the bacteriology of tuberculosis, treated with scorn the time-honored idea of codliver oil exerting a curative effect on tuberculosis. It was stated didactically and dogmatically that codliver oil was a food and nothing more and that all it did was to build up the body and to increase the resisting powers against disease. Anyone who argued to the contrary did not know what he was talking about. However, certain recent experiments appear to show that, after all, the doctors of years gone by were not so very far wrong. Dr. J. C. McWalter, in a letter to the *Medical Press and Circular* of September 8, points out that Sir Leonard Rogers and others experimenting on certain oils as regards their influence on cancer, have demonstrated that codliver oil has a specific effect on tubercle and on other acid-fast bacilli, like those of leprosy. But, granting that codliver oil can kill tubercle bacilli, McWalter asks whether it really does get at them in their snug alveolar retreat. Other recent experiments, however, seem to prove this very point, at least, that oils, when taken by the stomach, find their way into the lung tissue and stimulate defensive cell formation there. In a letter to the same journal for September 15, 1920, Dr. John Knott says that the administration of fat to tuberculosis subjects suggested itself to primitive reasoning, but the victim of that fell disease loathed fats, congenitally, and utterly failed to assimilate them physiologically. Saponification was shown to be an essential step in the digestion of adipose material and codliver oil was found to be the most easily saponifiable. Therefore, the therapeutic effects of codliver oil in the treatment of tuberculosis at the present time seem to be that it probably really has a specific action on the tubercle bacilli, that of course it has a food value, a flesh-forming and thus a fortifying effect, and lastly, that methods have now so diminished its nauseating features that it is amenable to the influence of the gastrointestinal fluids, that is, that it can be digested by the tuberculous with fair facility.—*Editorial, Med. Rec., November 6, 1920, xcviii, 778.*

Food Values in Tuberculosis.—Tuberculous patients require more food than the average amount needed by the ordinary laborer. The minimum for patients (almost

all adults) at the Gateford Sanatorium is 3500 calories. The diet must be rich in protein and fat; protein, 4 to 4½ ounces per head per day; fat, 4 ounces per head per day The fat should be largely animal fat, particularly in the form of milk and milk products. If margarine is used it should be oleomargarine and not made from vegetable fats. Eggs should be in the dietary. When they are not supplied their place should be taken by an extra amount of meat, given according to accurate calculations. Whole meal bread, beans, peas, and lentils should always be used, together with a plentiful supply of fresh fruits and vegetables. Each patient requires two pints of milk per day.—*Some Remarks on Food Values in Tuberculosis, H. de C. Woodcock, Lancet, October 23, 1920, cxcix, 842.*

Chaulmoogra Oil and Tuberculosis.—The recent widely circulated statement that the U. S. Public Health had found that chaulmoogra oil was as efficacious in the treatment of tuberculosis as it had been shown to be in that of leprosy is said by Surgeon General Cumming to be unwarranted. Experiments made some years ago with the oil gave no definite results. Recent experiments with the ester or derivatives have been begun because of hopes based on some similarities between the bacilli of leprosy and those of tuberculosis; but these have not proceeded far enough to indicate what results will be obtained.—*Health News, United States Public Health Service, December, 1920.*

Mercurochrome and Mercurophen in Experimental Tuberculosis.—Mercurochrome-220 (a mercury compound of fluorescin) inhibits the growth of the tubercle bacillus completely in a dilution of 1:5000 and kills in a dilution of 1:100 in twenty-four hours. Mercurophen (sodium oxymercury-orthonitrophenolate) inhibits growth in a dilution of 1:50,000 and kills in a dilution of 1:10,000 in twenty-four hours. There was but little beneficial action from either of the drugs on experimental tuberculosis of guinea pigs. Still, it seems possible that mercurophen might be used with benefit in lupus and in ulcerating tuberculous conditions of the throat, larynx or bladder that are accessible to local treatments.—*Action of Mercurochrome-220 and of Mercurophen. A Preliminary Report of Effects on the Human Tubercle Bacillus and on Experimental Tuberculosis in Guinea Pigs, Lydia M. DeWitt, J. Am. M. Ass., November 20, 1920, lxxv, 1422.*

Quinine in Hemoptysis.—Strobel reports favorable results from the administration of five grains of quinine every four hours for a week in cases of hemoptysis. Assuming that the theory of mixed infection was the correct explanation of hemoptysis, he injected into 54 rabbits subcutaneously 0.5 cc. of fresh, bloody sputum from as many different patients during different seasons of the year. The result was that in 51 of the rabbits lobar pneumonia and pneumococcic septicemia developed, in 2 a localized tuberculous abscess, and in one an abdominal abscess. Five of the 51 rabbits were controlled by a rabbit of similar weight, receiving a similar inoculation, but which had been given fifteen minutes previously one grain of quinine bisulphate intravenously. These controls were killed after two to three months, when they presented all organs and blood free from tubercles and diplococic pneumonia.—*Quinine in the Treatment of Hemoptysis, J. E. Strobel, Med. Rec., August 21, 1920, xcviii, 313.*

Liquid Acid Nitrate of Mercury in Lupus.—Liquid acid nitrate of mercury is an efficient caustic remedy in the treatment of lupus. It is freely painted by means of a cotton swab on the affected areas, and with firm pressure for one or two minutes, and with care to limit the application exactly to the lupus patches, isolated nodules or ulcerated surfaces. In the case of isolated nodules or nonulcerated patches, the effect of the application is seen after a minute or two by the change in the appearance of the typical lupus tissue to a dry, opaque, yellowish-white. No dressing is applied and the patient is seen again in a week. The lesions then are covered with a thin brownish crust. This falls off in a few days and either leaves the affected areas completely healed or presents a shallow ulcer which heals rapidly. In some cases a single application is sufficient. In others isolated nodules remaining in the scar necessitate repeated applications. The applications are only slightly painful, but they are followed by more severe pain for several hours. In ulcerated lupus all crusts are removed, and the solution is freely painted on the raw surfaces. This causes considerable pain, but it is well borne by patients if not too large an area is done at one sitting. The surface of the ulcer first becomes yellowish white, but in a few days much serous exudation gives rise to a thick heaping up of crust. At the end of a week, the crusts are picked off, leaving a purulent surface with a pink healthy margin. The number of applications depends upon the extent of the disease and the depth of the inflammatory infiltration accompanying these ulcers. In lupus of the nose, the solution may be carefully painted on the lesions of the mucus

membrane, as well as on all nodules or ulceration on the skin surface. In extensive cases it can be done at one sitting under a general anesthetic, or it can be carried out gradually covering a little surface at a time without an anesthetic. The results in this form of lupus have been better than with other methods of treatment, but as yet no complete cure can be claimed in extensive cases. The remedy has not been used for a sufficient length of time to effect such a cure, but the good results obtained justify its more general use.—*The Treatment of Lupus Vulgaris by the Liquid Acid Nitrate of Mercury, H. G. Adamson, Brit. M. J., July 24, 1290, 123.*

Treatment of Enclosed Tuberculosis Lesions by Oxygen.—This method has been used successfully by Rost in the treatment of tuberculous joints, psoas abscess, and tuberculous peritonitis. In the case of joints, for instance, the joint is drained of fluid by puncture, iodin solution—1 dram to the pint—is run through, and the joint is then inflated with oxygen. Only one treatment has been necessary in these cases. The joint is then apparently normal, and functioning. In cases of tuberculous peritonitis, the peritoneal cavity is filled with oxygen. Psoas abscess sinuses are injected with oxygen twice daily. Full details of the treatment are given.—*Treatment of Tubercular Affections of Enclosed Cavities, Abscesses and Caries, by Inflation with Oxygen, E. R. Rost, Indian M. Gaz., September, 1920, lv, 329.*

Tuberculin, Its Uses and Abuses.—The author is an enthusiastic adherent of tuberculin treatment. Just as a slight infection with living tubercle bacilli, if recovered from, confers a certain degree of immunity on the patient, so small doses of tuberculin will do the same thing. Active disease should not be treated with tuberculin. The active symptoms may first be controlled by rest in bed and other appropriate measures. After they have subsided, one ten-millionth of a milligram of tuberculin is given, and the dose progressively doubled at five day intervals, until 1 mgm. is reached. This takes about 30 doses or 150 days. This maximum dose is kept up at fortnightly intervals for a year. In afebrile cases the starting dose is one ten-thousandth of a milligram. If there is no reaction, the dose is progressively doubled as described above. If there is a reaction at any stage, the last dose is repeated, and if the reaction persists, a still smaller dose administered. The author obtained favorable results in tuberculosis of the spine, joints, lungs and in scrofulous children, especially those with phlyctenular conjunctivitis.—*Tuberculin, Its Uses and Abuses, R. H. Cowley, Kentucky M. J., September, 1920, xviii, 30.*

Tuberculin Treatment. Immunization against tuberculosis can be obtained naturally and artificially to a certain extent, and hence vaccination of man is no idle dream. To date it has not been fully realized, but tuberculin treatment reinforces the resisting powers, and usually, in the course of months, slight improvement may be counted on if the forces of the organism are still capable of offering resistance to the infection. The tuberculin is merely an adjuvant. An experience of fifteen years has demonstrated its efficacy in many cases. In tuberculosis every physical trauma no matter how insignificant, augments the virulence of the bacilli and reduces the resistance of the cells in the foci. Repose is indispensable in treatment of the tuberculous. They must avoid all work, all sports, and everything that induces fatigue. Tuberculin must never be given in amounts large enough to induce an appreciable reaction in the focus. It probably always acts on the focus, but this action must never be pronounced enough to be clinically apparent. The diagnostic importance of tuberculin is sustained anew by three cases in which supposedly healthy persons gave a positive conjunctival reaction but, as they never showed any signs of tuberculosis, no attention was paid to the findings of the test, until three years, six and eight years later extremely severe tuberculosis became manifest. It would be absurd to treat for tuberculosis every one giving a positive skin or intracutaneous test, but this should be the rule when tuberculin tests elicit exaggerated positive responses.—*Étude sur l'action thérapeutique de la tuberculine, M. Jacquerod, Rév. Méd. d. l. Suisse Rom., June, 1920, xl, 333.*

Tebelon in the Treatment of Surgical Tuberculosis.—Tebelon is a proprietary preparation consisting of the isobutyl esters of fatty acids from the tubercle bacillus. Stoeltzner, who isolated the substance, believes that it stimulates the production of antibodies against the waxes of the tubercle bacillus. The results on 19 cases are reported, including bone, joint, gland and skin lesions. In 10 complete healing occurred within one and a half to three months. Not only were fistulae closed, but by X-ray there was evidence of regeneration about areas of osteosclerosis. Five cases were improved while in 4 the condition remained the same. The usual surgical and ortho-

pedic measures were continued during the Tebelon treatment. Cases showing a positive Pirquet reaction before treatment showed none after its completion. One cubic centimeter of tebelon was injected subcutaneously into the back every third day. No ill effects attended its use. If antibodies are formed which are capable of dissolving the capsule of the bacillus, the absence of fever is difficult to explain.—*Tebelon in der Behandlung der chirugischen Tuberkulose, W. Baensch, Münch. med. Wchnschr., August 27, 1920, lxvii, 1009.*

Specific Treatment of Tuberculosis at High Elevation.—Carl Spengler describes the treatment with the so called immune bodies as applied in Davos, Switzerland. During one week before the specific treatment is begun hemoglobin is administered to enhance the formation of red blood cells. Iodine with albumen by mouth or inunctions of iothion are also given. For cough and pain codeine or codeine and morphine are given by mouth, and for insomnia due to the tuberculosis poison, hypnotics such as dial, bromural, and adalin, until the specific treatment has had time to manifest its beneficial effects. The open air cure must be adapted to the individual case. Rest on the steamer chair out of doors is not continued longer than an hour or two morning and afternoon, and in the winter is ordered only on bright, sunny days. By this plan the patients gain much more weight than they do upon the arbitrary open air treatment. Anemic and anorexic patients are not put out of doors at all in the winter season at high altitudes. In cold weather all patients are put in warm beds in their own rooms in the afternoon, with the windows open. Undoubtedly many therapeutic failures at high altitudes are due to excessive open air treatment. The immune bodies or IK are given either hypodermically, by inunction, or by the mouth. One of the chief rules of administration is never to increase the dose where the patient's temperature continues to descend. In contrast to tuberculin therapy, increased dosage is indicated only when the temperature has become stabilized or has begun to rise again. Tuberculin is dangerous except in the hands of specialists, while the immune bodies may be used by any physician without risk in all cases that are not far advanced. Increased dosage is, furthermore, employed only when local reaction from the previous amount has completely disappeared. Inunctions are given at weekly intervals, and by mouth the remedy is given two or three times a week. Excellent analgesic and curative results have been noted from applications of a 0.1 per cent solution of IK to tuberculous ulcerations. Pain and photophobia accompanying eye lesions are also similarly relieved. Iodine, with albumen, is particularly indicated in scrofulosis and torpid tuberculosis. In children one or two drops and in adults five or six drops of freshly prepared tincture of iodine, diluted in a cupful of milk, are given at breakfast for two weeks, to be followed by an equal period of rest, and so on. Such medication should be applied *en masse* in schools and among children showing signs of tuberculous heredity or incipient tuberculosis. Iothion inunctions—0.5 to one gram a day—are administered, like mercury, on different surfaces of the body, in fortnightly courses followed by rest for an equal period. By this plan of treatment permanent recoveries are obtained in ninety to one hundred and fifty days in many cases of tuberculosis not yet too far advanced. Artificial pneumothorax and extrapleural thoracoplasty are indicated only in cases in which specific immunizing therapy has failed, and can only prove successful when there is collapse of the lung, and autoimmunization due to the lung collapse. Specific therapy and iodine with albumen should always precede such measures in order to improve the condition of the lung tissues and increase their ability to undergo atelectasis.—*Le traitement spécifique de la tuberculose à l'altitude, C. Spengler, Presse Méd., April 24, 1920, No. 25, 2441.*

Treatment with Partial Antigens (Deycke-Much).—The treatment was tried on 156 cases which had previously been under observation for several weeks. One hundred and forty-six were uncomplicated pulmonary cases; 10 showed bone and gland lesions only. The former were classified clinically as cirrhotic-nodular, nodular, or nodular-pneumonic types. Eight days before commencing treatment all patients were given intracutaneous tests with the several antigens, M Tb R, A, F, and N. These were repeated two or three weeks before the end of the treatment. Twenty-five patients were treated with the partial antigens, A, F, and N only; while the remainder received M Tb R only. In a first small group of 10 the initial dose was determined by the reaction to the intracutaneous test. The second group was likewise started in this manner, but later the highest dilution (0.1 cc. = 1: 100,000 mil.) was employed. The average duration of treatment was five or six months. Most of the cases were kept at rest and all were given the usual dietetic and fresh air treatment. The authors conclude that the treatment is only beneficial as

an adjunct to the usual dietetic and hygienic measures in incipient cases; and that even in these it is in no way superior to the ordinary tuberculins. They add that no ill effects have been observed. For diagnostic purposes little insight is gained as to the action of the defensive mechanisms of the body. *Erfahrungen über die Partialantigene (Deycke-Much), L. Jacob and M. Blechschmidt, Münch. med. Wchnschr., April 1, 1920, lxvii, 447.*

An Attenuated Tubercle Vaccine.—Raw thinks that human and bovine tuberculosis are separate and distinct diseases, but that the human body is susceptible to both, especially to bovine tuberculosis in the early periods of life. The two diseases are so rarely seen in the same subject that there are strong grounds for presuming that they are antagonistic to each other and that bovine tuberculosis may confer an immunity against human tuberculosis and vice versa. Possessed of this idea Raw has secured nonvirulent cultures of both human and bovine bacilli. From these he prepares separate tuberculins. Cases of glandular tuberculosis, and all tuberculosis in children, which is evidently of bovine origin, he treats with the tuberculin made from the human type, while, on the other hand, cases of pulmonary tuberculosis are due to the human type. He says that tuberculin should always be prepared from attenuated and nonvirulent cultures; that it should be freshly prepared and used within a week; that it should be given in graduated and increasing doses at intervals of seven days; that acute reactions are not necessary; that not less than twelve injections should be given at intervals of one week; and that the most favorable cases for treatment are local lesions, but early cases of pulmonary tuberculosis may be limited and a further spread to other parts of the lungs prevented. —*Editorial, J. Lab. & Clin. Med., September, 1920, v, 813.*

Surgical Tuberculosis Treated by the Friedmann Method.—Fifty-two cases were treated by this method during 1914. The ages ranged from one and a half to sixty-nine years, 30 of the patients being under ten years old. The lesions were in the bones, joints, glands, skin and genitourinary tract. In 14 the Friedmann vaccine was exclusively employed; in the rest it was combined with surgical procedures. Injections were made into the gluteal muscles, sometimes repeated once a week or more. A year later, 7 of these cases were completely healed, 30 showed temporary improvement, 13 were unimproved, and one had died. Five or six years later, 47 were again followed up. Nine had died, 6 of tuberculosis; and of these, 3 died within a month after their discharge. Two died from causes other than tuberculosis. Six patients, although improved, failed to show complete healing. Thirty-two showed no trace of tuberculosis. The complete history of one patient with a tuberculous peritonsillar abscess, who recovered under the treatment, is given. A case of coxitis was treated, relapsed after three months was again treated and showed marked improvement and entire freedom from pain. A case with genitourinary tuberculosis is under observation in which the improvement was interfered with by a smallpox vaccination.—*Die Behandlung chirurgischer Tuberkulosen mit dem Friedmannschen Mittel und ihre Ergebnisse nach 6 Jahren, F. Krumm, Münch. med. Wchnschr., July 23, 1920, lxvii, 870.*

Treatment of Surgical Tuberculosis with Cold Blooded Tubercle Bacilli.—Patients are given subcutaneous or intramuscular injections of living turtle tubercle bacilli. Fistulae are treated by direct application into the tract. The dose is from 0.25 to 0.3 cc. of a homogeneous suspension of the organisms. The concentration of the suspension is not of great moment, as the bacilli are avirulent and nontoxic. The intramuscular injections are made into the gluteal or deltoid muscles. If the hard nodules arising at the site of injections become softened, raying with direct sunlight or roentgen ray (with a 2 mm. aluminum filter) soon restores them to their previous hard condition. With three exceptions, all cases so far treated have been ambulant. No ill effects have been noted with the occasional exception of a slight temporary rise in temperature. The result, especially in children, is a prompt "fixation of toxin" manifested by a disappearance of nightsweats, an increase in appetite and in weight and prompt improvement of the general appearance. It is alleged that the cold blooded tubercle bacillus vaccine is a specific for tuberculosis and scrofulosis. The prognosis is better the earlier treatment is commenced.—*Über, die Behandlung der chirurgischen Tuberkulose mit Kaltblüter Vakzine, Brandenstein, Münch. med. Wchnschr., July 2, 1920, lxvii, 786.*

Extrapleural Thoracoplasty.—By improving his technique the author has reduced his operation mortality from 30 to 4 per cent. Of 33 patients surviving the operation 15 obtained a curative result. The following summarizes his experience:

In unilateral or mainly unilateral pulmonary tuberculosis, which is not cured by rational treatment (including pneumothorax), good results can be achieved by the operation. Fxtrapleural thoracoplasty should be performed only after conference with the physician treating the patient, who must have had an opportunity, by observation during a considerable period, of forming a thorough opinion of the prognosis in the case concerned. Resection of the ribs should be carried out under local anesthesia through a paravertebral incision, so that the posterior part of the ribs from the eleventh, or, in any case from the tenth to the first inclusive, can be removed. If a cavity remains, it can be brought to collapse by means of intrathoracic transplantation of fat. It is necessary that practising physicians should acquire knowledge of the indications and results of extrapleural thoracoplasty. One has now no right to withhold the chance of operation from suitable patients.—*Extrapleural Thoracoplasty in the Treatment of Pulmonary Tuberculosis, With an Account of 37 Cases, P. Bull, Lancet, October 16, 1920, cxclx, 778.*

The Albee Operation for Tuberculosis of the Spine.—Over 100 cases have been treated, but this report deals with only 60, operated upon from September, 1913, to August, 1918. All cases of unhealed tuberculosis of the spine were subjected to this treatment, the only contraindications being the contamination of the operative field by fistulae or wounds, and the occurrence of paralyses or poor general condition of the patient. The ages of the patients varied from one to forty-eight years, 44 being ten years and under. A questionnaire was sent out at the end of 1919 to all operated patients. Only 57 could be considered, as 2 had died within a year after the operation and in 1 the graft had not taken. All but 8 of these were traced. Of the 49 remaining, 42 showed apparent, and 26 permanent, healing. Such bone implantation is a procedure without serious technical difficulties and offers the patient early and permanent recovery. If deformity has not already been established it is prevented; if kyphosis exists its further development is checked.—*Über unsere Erfolge mit der Albees'chen Operation in 60 Fällen von Wirbelsäulentuberkulose, Görres, Münch. med. Wchnschr., July 30. 1920, lxvii, 896.*

Treatment of Tuberculosis of Spine.—The total number of cases reviewed by Stone is sixty-five. Thirty-three patients were operated on in one way or another while the remaining thirty-two received what is termed conservative treatment. On the basis of his findings Stone does not recommend ankylosing operations for tuberculous spine in children. About 19 per cent of cases of Pott's disease treated in the usual way developed abscesses. Fourteen, or over 42 per cent, of thirty-three operative cases, had abscesses. Operation has not prevented increase in deformity, and after-care must be carried out during as long a time following operation as if nothing had been done. The mortality of operative cases was 15 per cent.—*Operative and Non-Operative Treatment of Tuberculosis of Spine, C. A. Stone, Missouri State M. Ass., September, 1920, xvii, 367.*

Temporary Disarticulation of the Foot for Tuberculosis.—Revel gives an illustrated description of three cases in which severe and extensive tuberculous processes in the foot, one of thirty years' standing, were cured by excision of all the morbid tissues. Access is obtained by Delbet's method of opening up the foot across, at the mediotarsal articulation or between the tarsus and the metatarsus, cutting the tendons, vessels and nerves of the dorsum of the foot. The joint thus opened up, the fore part of the foot is swung down and the region is thus exposed like an opened book. Supplementary lengthwise incisions afford still more complete access, and the diseased soft parts and bones can be scraped and cleaned as perfectly as in preapring an anatomic specimen. The fore part of the foot is then sutured back in place and heals by primary intention. The foot is shortened by the total of bones that have had to be resected, but it answers the purpose of a foot, and the tuberculous lesion is a thing of the past. In one of the cases described, the lesion was of two years' standing, and he had to resect the scaphoid, cuboid, third cuneiform and part of five metatarsal bones; in another, the entire anterior tarsus and part of four metatarsal bones. In the third the astragalus had to be removed.—*De la désarticulation temporaire du pied pour tuberculose, J. Revel, Rev. d. Chirurg., 1920, xxxix, No. 3, 205.*

Preparation of Tuberculins for Diagnosis in Animals.—Uniform methods for the preparation of tuberculin must be instituted. During the past two years observations were made to determine the influence of certain changes of technic upon the potency of the product with the following results: Beef bouillon tuberculin is as potent as that prepared from veal. The growth on 3 per cent glycerin broth is not as good as that on 5 or 7 per cent broth.

Acid potassium or acid sodium phosphate may be substituted for sodium chloride in the culture medium. Tubercle bacilli of bovine or human type are equally suitable for producing tuberculin. Four weeks' old cultures are usually impotent. There is little difference between cultures older than eight weeks and up to twelve weeks. Tuberculin heated at 100°C. for three hours in the Arnold steam sterilizer is more potent than when unheated and autoclaved. Tuberculin kept in diluted form was found as potent after five or six years as the concentrated form. Berkefeld filtering does not alter the potency and should be practised. With carbolic acid as preservative the percentage seems to play no important part up to 1.5 per cent. Twelve affected guinea pigs should be used to compare the potency: 3 receive 4 c.c.; 3, 3 c.c.; 3, 2 c.c.; and 3, 1 c.c. per 500 gm. body weight.—*The Preparation of Tuberculins for the Diagnosis of Tuberculosis in Animals, F. Boerner and M. F. Barnes, J. Am. Vet. M. Ass., November, 1920, lviii, 165.*

Combination Tuberculin Tests on Cattle.—It was observed in the work of the Pennsylvania Bureau of Animal Industry in 1913, when the subcutaneous and intracutaneous tests were applied simultaneously, that the subcutaneous test had a modifying effect on the intracutaneous reaction. This has been confirmed subsequently by Turner's work. The intracutaneous test when applied three days prior to the subcutaneous interferes with the subcutaneous reaction. When the subcutaneous test is applied a few days prior to the intracutaneous, it has a marked influence on the latter, but the interference is not as decided as when the intracutaneous precedes the subcutaneous test. The conjunctival test can be applied in any combination without being interfered with, or influencing the other tests. In animals which have reacted to the conjunctival test a return of the conjunctival reaction when later retested by the subcutaneous method has been observed. In one herd this occurred after a period of seventy-eight days. Of the 18 animals which had reacted to the previous conjunctival test, 13 showed a return of the local reaction. From the results here shown, as well as from the observations of others, it is evident that a uniform plan for applying the combination tests is needed.—*Combination Tuberculin Tests, H. W. Turner, J. Am. Vet. M. Ass., November, 1920, lviii, 165.*

Superiority of Combination Tuberculin Tests on Cattle.—The records of the Federal Bureau of Animal Industry indicate that during the fiscal years 1918, 1919 and 1920 approximately 1,100,000 head of cattle were tuberculin tested under the coöperative plan. The combination test starting with the intracutaneous injection and the sensitizing ophthalmic disk, followed in seventy-two hours by subcutaneous injection and diagnostic ophthalmic disk, should be carried out in badly infected herds. Experimental work showed the ophthalmic method somewhat superior to the other recognized methods. The advantage of the combination test was fully demonstrated. Two reactors and one suspect were found, as results by the subcutaneous method, and two reactors and one suspect by the intracutaneous method. No case of generalized tuberculosis was missed as a result of the combination tests. Special arrangements should be made to have reactors autopsied by men especially qualified. In summarizing the results obtained from combination tests, the following points stand out: (1) Each method of testing has its value. (2) The use of all methods should be encouraged. (3) The combination of methods, having proved its superiority, should be used on all badly infected herds or on any animal of doubtful health, and in retesting suspicious animals. (4) There should be fewer animals classified as suspicious as a result of combination tests. (5) The most careful postmortem work is essential.—*The Superiority of Combination Tuberculin Tests Over Any Other Method, L. H. Ernest, J. Am. Vet. M. Ass., November, 1920, lviii, 174.*

Eradicating Bovine Tuberculosis in Pennsylvania.—The following conclusions were reached, based on the results of testing 964 herds under the accredited plan and 12 herds owned by public institutions: (1) A definite plan for suppressing, controlling or eradicating tuberculosis is indispensable. While the officially accredited herd plan, as now drawn, can be improved upon in some respects, yet it is recognized as the best plan so far advanced for dealing with the proposition on a nation-wide basis. (2) A definite method of applying the different tests has worked well in Pennsylvania. (3) After seven years' trial it has been proved that in order to free infected herds from tuberculosis the combination tests must be used. (4) As the disease decreases the inefficiency in no-lesion cases increases, that is, cattle are condemned which on autopsy show no visible lesion of tuberculosis. This may be due to conditions producing pus, to parasitic diseases, actinomycosis, atmospheric changes, pregnancy, inexperienced testers, and idiosyncrasy to tuberculin. (5) No-lesion cases must be reduced by 50 per cent by a complete history taking of the

herd before classifying animals as tuberculous. An excellent method in animals, which cannot be properly classified, is to slaughter first those which give the strongest reaction and are supposedly tuberculous, and to continue slaughter of animals as long as the disease can be demonstrated. (6) Tests must be conducted in the most careful manner and treated as a delicate major operation.—*Eradicating Tuberculosis in Pennsylvania, S. E. Bruner, J. Am. Vet. M. Ass., November, 1920, lviii, 147.*

Disposition of Tuberculous Cattle.—No practical or scientific method is in use at the present time for disposing of tuberculous cattle. Concentration farms should be instituted to which all reactors should be shipped. Valuable purebreds should be conspicuously marked and their history sent to the farm manager. Valuable females should be sent to a second farm where they would receive better care. Calves are to be sent to a third farm where no tuberculous cattle are harbored and are to stay there until tested and passed by two tuberculin tests. From May, 1918, to July, 1919, an abandoned farm was rented and equipped like any regulation farm. The milk obtained was used for the preparation of condensed milk, which process sterilizes the milk. This and the sale of veal calves helped to reduce expenses so that the average cost of each reactor handled through this farm was 19 cents. This project ought to be undertaken as a permanent State project.—*Disposition of Tuberculous Cattle, O. H. Eliason, J. Am. Vet. M. Ass., November, 1920, lviii, 155.*

Chemical Disinfection of Tuberculous Sputum.—A solution already used with success by Küss for several years is highly recommended for this purpose. It consists of soft, potash soap, 8 grams; crystalline sodium carbonate, 10 grams; 35 per cent formaldehyde solution, 40 c.c., and water, enough to make 1 liter. This soapy, alkaline solution, containing 4 per cent of formaldehyde, liquefies the sputum thoroughly and certainly kills the tubercle bacilli in from fifteen to twenty hours. The solution is, moreover, odorless, gives off no irritating fumes, is of low toxicity, is easily handled, facilitates cleansing of sputum cups by its liquefying property, and can be prepared by any one at slight expense. The practitioner is urged to use this solution whenever circumstances do not permit of disinfection of sputum either by boiling water, steam, or incineration.—*Comment désinfecter les crachats des tuberculeux. E. Arnould, Presse Méd., April 3, 1920, No. 19, 333.*

Public Health Service Warns Consumptives.—The migration of army patients suffering with tuberculosis to the semiarid West is causing the United States Public Health Service no little concern, for all the Service hospitals and all the contract hospitals in that region are now completely filled. It is considered to be very unfortunate that the patients should leave places where the government is ready and able to care for them and go to other sections where it is absolutely impossible for it to provide proper care and where even ordinary housing accomodations are largely unobtainable. The Service is making and will continue to make strenuous efforts to meet the needs of the patients, but the great amount of travel to that part of the country makes the problem very serious.—*Health News, United States Public Health Service, December, 1920.*

Dust Hazard in an Ax Factory.—The average tuberculosis death rate for the period 1900–1918 inclusive for male persons in Connecticut is 1.7 per 1000. For the employees other than polishers and grinders in the big ax factory at Collinsville it is 1.6, and for the polishers and grinders it is 10 times higher. These workers are ruled out of all the life insurance companies, since the constant inhalation of the grit and bits of steel thrown off in the process induces "grinders' consumption." Americans would not work in these rooms. French Canadians used to do it for a few years and then go home to linger a while and die. Swedes took up the work and would get the disease in nine or ten years. Now Finns and Poles are at it and last only three to five years. The enormous tuberculosis incidence is due to the hazards of wet grinding on sandstone wheels. The substitution of dry grinding with an efficient exhaust system (or possibly the use of wet grinding on artificial abrasive wheels of a harder nature) is clearly indicated as a measure for the protection of the workers against respiratory disease.—*A Study of the Dust Hazards in the Wet and Dry Grinding Shops of an Ax Factory, C.-E. A. Winslow and Leonard Greenburg, U. S. Public Health Rep., October 8, 1920, xxxv, 2393.*

Deaths and Death Rates from Pulmonary Tuberculosis in New York City and State.—The following table, showing the death and death rates from pulmonary tuberculosis for New York City and State, for September during the years 1913 to 1920, inclusive, is taken from the *Monthly Vital Statistics Review, New York State Department of Health, November, 1920, New Series, vol. 1, no. 9.*

Pulmonary tuberculosis: Deaths and death rates, New York State and large subdivisions, September, 1913 to 1920*

MONTH	YEAR	NEW YORK STATE		NEW YORK CITY		REST OF STATE							
						Total		Urban		Rural		Institutions [illegible]	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
September average	1913–17	1,036	124.6	646	143.7	390	102.3	187	101.1	203	103.4		
September	1913	961	120.2	577	135.0	384	103.2	179	98.9	205	107.9		
September	1914	1,109	136.0	693	158.5	416	110.7	206	111.4	210	110.3		
September	1915	992	119.3	647	144.0	345	90.5	164	88.6	181	92.2		
September	1916	984	116.5	602	131.1	382	99.2	196	104.6	186	94.2		
September	1917	1,136	131.8	711	151.2	425	109.1	193	101.2	232	116.0		
September	1918	932	106.4	554	115.1	378	95.9	164	84.5	176	87.5	38	
September	1919	822	92.0	478	97.1	344	86.2	139	70.3	172	85.1	33	
September	1920	741	81.7	418	83.1	323	80.1	124	61.0	163	80.1	36	

* Deaths per 100,000 population per annum.

Annual Report of the Health Officer of Newcastle-upon-Tyne for 1919.—The tuberculosis medical officer reports 10,332 consultations as against 11,517 in 1918 and 9286 in 1917, at the dispensary. There were 724 new cases, 76 less than in 1918, and 455 deaths, the lowest mortality yet reached. Twenty per cent of the cases were first discovered by the tuberculosis officer among the home contacts of the known patients. Remedy of the housing shortage and an active aftercare organization are necessary for the full effect of the preventive work. Many cases still come for treatment too late for any hope of cure. Of 853 patients treated in Corporation beds at Barrasford since 1908, at the end of 1919 there were 31 still in the institution, 233 well, working or fit to work, 101 improved or moderately well, 38 relapsed, 329 dead, and 121 lost sight of. One hundred and seventy-three advanced cases were discharged from the sanatorium pavilions, Walker Gate, and 14 of these were fit to work, 67 were improved, 44 unimproved, and 48 died in the hospital. The great value of the sanatorium pavilions lies in the prevention of the infection of other members of a household where the home conditions are not such as to permit of sufficient precautions being taken, and to some extent in the patching up of patients sufficiently to allow a proportion of them to return to work for a further period. Four hundred and ninety-six deaths were registered as due to tuberculosis; of these 346 were due to pulmonary tuberculosis and 150 to other forms. The death rate per 1000 population due to tuberculosis was 1.8. Of the 496 who died, 249 were known to the dispensary staff. The average duration of illness was 37.6 months in males and 27.3 months in females. The average period between notification and death was 14.3 months. This is greater than in previous years. The death incidence was highest among laborers in males, house workers in females. In 33.45 per cent there was a history of active tuberculosis in a near relation. Among the new developments at the dispensaries are additional consultation sections, improvements in the records of the patients, research into the relationship between influenza and tuberculosis, X-ray, closer relationship with general practitioners, who sent in 50 per cent of the dispensary cases. Half of the visits at the dispensaries were made by children.—*Annual Report of the Medical Officer of Health of the City and County of Newcastle-Upon-Tyne, During the Year 1919, W. H. Dickinson, Tuberculosis Medical Officer.*

Tuberculosis in Primitive Tribes.—A study of the geographic distribution of tuberculosis shows that there are still many large tracts of the earth's surface where this disease is rare or absent. Members of isolated communities, where tuberculous disease is rare or absent, show, in comparison with members of infected communities, a marked susceptibility to the disease. The relatively high resistance to tuberculous infection manifested by the majority of individuals in infected communities is attributable to acquired immunity resulting from previous contact with the disease. The susceptibility of African and other primitive races to tuberculosis is the susceptibility of virgin soil. A theory of infection and resistance in mutual interaction is capable of explaining these statistical correlations that have been adduced to support the theory of inherited disposition. All the phenomena of variation in clinical type, comparative mortality, distribution, according to age, sex, locality, and occupation, noted as characteristic of tuberculosis in a highly organized community, are explicable in terms of infection and resistance. Recent statistical investigations support the assumption that mild infections with bovine bacilli may play an important part in raising the general resistance to the human type of tuberculous disease. One of the results of this increased resistance may be the production of greater chronicity of phthisis pulmonalis, a lengthening of the life of bacillus carriers and excreters in the parental period, and a consequent increase of danger to infants and children. These considerations indicate that exhaustive research is still necessary in order that efforts at the control of tuberculosis may be directed along effective lines.—*Tuberculosis in Primitive Tribes and Its Bearing on Tuberculosis of Civilized Communities, S. L. Cummins, Internat. J. Publ. Health, September, 1920, i, 137.*

The Hereditary Factor in Tuberculosis.—There still appears to be a good deal of misundertanding as to what the hereditary factor in tuberculosis really means. It is supposed that certain constitutions are more and certain other constitutions less resistant to pulmonary tuberculosis. It is immaterial whether the tuberculous diathesis be looked upon as an inheritance of susceptibility or an inheritance of resistance, for both are but grades in the scale of immunity peculiar to the individual. In a community where tuberculosis has been prevalent for many centuries, it is anticipated that natural selection would steadily intensify the immunity by eliminating those with less resistance. The higher grades of resistance survive and are transmitted by heredity. In a community wherein the tubercle bacillus has not been introduced there will have been no selection to raise the average degree of

immunity. There will, however, be many grades of susceptibility, and these will be inherited, whether or not they have been put to the test of an infected environment. The theory of an inherited resistance is not affected in any way by the well-known fact that isolated groups of mankind have little resistance to tuberculosis. It is rather what we should expect on the theory of evolution by natural selection with the transmission of hereditary characters.—*The Hereditary Factor in Tuberculosis, K. Pearson, Lancet, October 30, 1920, cxcix, 891.*

The War and Tuberculosis Among the Children of Munich.—Analysis of the histories of 1940 patients at the University Pediatrics Clinic from 1912 to 1919 inclusive showed that the incidence of positive Pirquet reactions occurred earlier in life during the years of the war than in those which preceded. The tuberculosis death rate among children throughout the whole city of Munich increased during the year 1916, while the rate for adults did not. This increase was confined chiefly to the ages from one to five. In 1917 the figure sank below that of 1914 and continued to fall during 1918 and 1919, although more slowly than in peace years. A possible explanation of the sudden increase is suggested in the fact that the previous two years of the war had brought to light many open cases of tuberculosis in adults. While all the ablebodied were engaged in military service the care of children was often left to the sick. In the later years of the war these conditions were remedied, children were brought into the country and their diet was carefully provided for even at a sacrifice on the mothers' part. The children of Munich were more fortunate than those of other German cities but it is to be feared that when these children, infected so early in life, reach school age severe forms of tuberculous disease may occur.—*Über die Einwirkung der Kriegsverhältnisse auf die Tuberkulosehäufigkeit unter den Münchener Kindern, J. Bartschmid, Münch. med. Wchnschr., August 13, 1920, lxvii, 957.*

X-Ray Studies of Bronchial Function.—Fluoroscopic observations and studies of the radiograms, following the accidental injection of an opaque substance into the tracheobronchial tree in a patient with a malignant tracheo-oesophageal fistula, seemed to disclose peristaltic action in the bronchi. This led to an experimentation on animals. Thorium, iodoform and bismuth injected into the bronchial tree of dogs caused their death. Barium in olive oil or petrolatum paste has given a safe means of studying bronchial function, radiographically. The following observations were made: (1) Injection of the left diaphragmatic bronchus and its branches shows lateral motion of the bronchus with each pulsation of the heart. (2) Synchronous with respiration, there is a bellows-like expansion and contraction of the trachea and bronchi, which is very obvious in the relaxed bronchus immediately after injection. This expansion and compression of the bronchi are probably produced by costal breathing. (3) A third movement of larger cycle was observed. This is a movement of long peristaltic wave (10 cm.) though of small amplitude. It seems to be a potent factor in the evacuation of the barium. It is too rapid for ciliary action. (4) Adrenalin injected into dogs, after filling the bronchi with barium, caused contraction of the bronchi. Benzyl-benzoate caused dilatation. 1 mgm. of muscarin, intravenously, induced bronchial spasm, which was relieved by adrenalin intravenously.—*Roentgen-ray Studies of Bronchial Function, J. G. M. Bullowa and Chas. Gottlieb, Am. J. M. Sci., July, 1920, clx, 98.*

Bacillary Dissemination.—From the bodies of persons who had had pulmonary tuberculosis in an apparently mild form but had died of other diseases, pieces of tissue were taken from various organs as kidneys, liver, spleen, suprarenals, and the clots of thrombosed veins and were inoculated into the peritoneum of guinea pigs. The results were positive in 57 out of 73 tests, confirming the frequent impregnation of remote organs with tubercle bacilli. This so called bacillary diathesis is latent or presents only trifling symptoms. The lesions are the consequence of repeated mild infections of organs in the condition of relative immunity, but oversensitive and consequently incapable of resisting a massive infection. The sudden deaths without an acute terminal syndrome in certain cases of pulmonary tuberculosis are examples of humoral allergy induced by this bacillary dissemination.—*La diathèse bacillaire et les bacilloses histologiques, M. E. Lenoble, Bull. d. l'Acad. d. Méd., July 27, 1920, lxxxiv, 65.*

Pathological Biology of Tuberculosis.—Human and bovine tuberculosis are subspecies of one and the same species. The difference in properties is probably due to adaptation to their hosts. The virulence of human bacilli can be increased so that they behave like bovine bacilli, and highly virulent bovine bacilli can be so attenuated that they possess only the qualities of human bacilli. The tuberculin and the partial antigens of human and bovine bacilli

are identical. There may be tuberculous infection without anatomic changes. Wolff found the granular form (Much's granules) in a perfectly normal gland of a child. Vaccination of animals with these glands produced tuberculosis. The most delicate tuberculin reaction is the intracutaneous. Intrauterine tuberculous infection, though rare, undoubtedly occurs. Tuberculous infection usually dates back to the first years of life. The majority of human beings become infected at that time. The result may be either progressive tuberculosis or complete cure. The overcoming of the infection produces natural active immunity. Cattle may be immunized against bovine tuberculosis with living human bacilli. Tuberculous animals are protected against reinfection. In countries where there is little immunity to tuberculosis, infection overpowers the individuals rapidly and the lesions produced differ from those seen in the immunized, as for instance in some of the little frequented localities in Turkey, the Argentine, Africa and Palestine. The immunity developed during childhood must be constantly kept up and strengthened during later life. Testing of the immunity of healthy persons with partial antigens at various periods reveals the following results: Cell immunity, tested by the intracutaneous test, remains relatively unchanged. Blood immunity, tested by complement fixation, changes very rapidly. Laboratory workers showed rapid increase in partial antibodies when working in the tuberculosis division. Increase in blood immunity gradually strengthens the cell immunity. Blood antibodies, supplied by the cells, rapidly destroy germs. The immune bodies in the tuberculous are in no way different from those in the nontuberculous immunized individual. They are directed unconditionally against reinfection, and conditionally against the organisms already in the body. This behavior is responsible for the chronic course of the disease. Rapidly progressing, that is, miliary, tuberculosis appears where there are no antibodies. Lack of antibodies may be due to nonformation, as in the child or the adult in noninfected countries, or to their disappearance, when they have never been present in sufficient quantities. This may be due to congenital weakness, or weakening influences in early life, such as insufficient food or disease. Breakdown of immunity may be caused by intercurrent diseases. Measles, whooping cough, influenza may attenuate or temporarily remove the tuberculosis antibodies. Other causes of breakdown are local disease of the lung, including the old focus, malnutrition, adolescence, pregnancy, hazardous occupations, overexertion of mind and body. The role of trauma is questionable, Probably its effect is due to the lowering of the general resistance. The local infections which butchers and laboratory workers contract while working with tuberculous material (human and bovine) remain localized, because of a previous immunization. Why cannot the unimmunized adult immunize himself as well as the child? The adult is more exposed to the reception of tubercle bacilli in massive doses on the one hand and on the other is not capable of forming antibodies as promptly as the child. A tuberculous individual can be cured only by improving his immunity. Serum can be an immune serum only when it contains all partial antibodies, and even then is only partially efficient, because it only improved the blood immunity. It should therefore be used in conjunction with a vaccine, because the latter confers cell immunity. The oldest vaccine is tuberculin. Commercial tuberculin is a mixture of the water soluble partigen L (Reintuberkulin) and the three water insoluble partigens R albumen, fatty-acid-lipoid and neutral fat (Tuberkulin-Rückstand). Old tuberculin contains also glycerine boullion. The reaction with L is harmful, due to toxin oversensitiveness; the reaction to the three residue partigens is beneficial, due to immune body oversensitiveness. The former must be removed by the administration of increasing doses of pure tuberculin, best in ointment form; the latter must be raised. Curative results are achieved with commercial tuberculin, because it supplies some of the partigens in usable form and helps to remove oversensitiveness. The variations in results are explained by the fact that lacking antigens are in nonusable form, and that anaphylaxis is not removed. Harmful results are caused by antigens, the corresponding antibodies of which have already been formed in the body. This leads to hypersensitiveness and absorption of antibodies. Before treatment is started, we ascertain the extent of the immunity by intracutaneous injection of the partial antigens; then we raise the immune body hypersensitiveness by vaccination with the three residue partigens. If this is not successful, treatment with partigen L is instituted until the anaphylaxis has been removed. The R partigens are then resumed. All forms of tuberculosis are suitable for this treatment, except where there is a complete lack of immune bodies, as in miliary tuberculosis. The results in the renal and peritoneal form have been splendid. To ascertain the efficacy of nonspecific measures such as sunlight, high altitude, sea climate, roentegn rays, hygiene

and diet, chemotherapy, orthopedics, surgery, pneumothorax, partigen tests are made before and after. Partigen testing affords exact biologic control over the specific and nonspecific tuberculosis treatment. It is difficult to gauge the value of protective immunization because of the chronicity of the disease. In spite of the statistical difficulties arising therefrom the problem should be constantly kept in mind.—*Pathologische Biologie (Immunitätswissenschaft), Hans Much*, 3. *Auflage, Verlag von Kurt Kabitzsch, Leipzig, 1920, pages 289–320.*

The Endothelial Cell in Experimental Tuberculosis.—The epithelioid cell is of definitely endothelial origin. The only reliable means of identifying and tracing this cell is, at the present time, a colloidal suspension of carbon, injected intravenously. Benzidine dyes will not accomplish this if used alone. There is little evidence that the local tissue elements take an active part in the process of tubercle formation until after the lesion is formed; the reaction is, in a sense, exudative, since the lesion is produced from cells which migrate to the site of inflammation. The lymphocyte appears late and is not to be considered as a potential epithelioid cell; its presence in the tubercles is as yet unexplained.—*Studies on Endothelial Reactions II. The Endothelial Cell in Experimental Tuberculosis, N. C. Foot, J. Exper. Med., November, 1920, xxxii, 513.*

The Endothelium in Experimental Pulmonary Tuberculosis.—The injection of a colloidal suspension, or solution, of carbon into the veins of a living animal, as recommended by McJunkin, furnishes an apparently reliable means of tracing the so called epitheloid cell of the pulmonary tubercle from its origin in the vascular endothelium to the lesion. Experimental tubercles are formed in the lung, as in the liver, primarily by cells originating in the capillary endothelium. These cells are probably present in small numbers in the normal lung lying free both in the alveolar wall and the air vesicles. In response to infection they proliferate in the capillary walls in the vicinity of the invading organisms, migrate in steadily increasing numbers, and, arriving at the site of the infection, further multiply and to some extent fuse to form the syncytia known as giant cells. The epithelial cell takes no active part in the process; its proliferation tends to repair denuded surfaces and is regenerative rather than combative or phagocytic in nature. This cell is free from carbon and stains only diffusely with carmine, in contradistinction to the endothelial cell which readily takes up both pigments in granular form. The cells of endothelial origin not only phagocytose tubercle bacilli, but carry them into the tissues, for example into lymph nodes, by way of the lymphatics, or into other lung lobules by way of the air passages, in which they are readily demonstrable.—*Studies on Endothelial Reactions. III. The Endothelium in Experimental Pulmonary Tuberculosis, N. C. Foot, J. Exper. Med., November, 1920, xxxii, 533.*

Weight Curves of Tuberculous Guinea Pigs.—The weight curves obtained by weighing weekly 9 normal guinea pigs were compared with those of 37 tuberculous untreated guinea pigs, and 56 animals which were divided into groups, each for different mode of treatment with various chemicals. The following conclusions were drawn: Normal guinea pigs of approximately the same age and weight and living under the same conditions run a uniform weight curve. This curve is easily modified by changes in diet, by acute infections and other variations in the conditions of life. Normal male guinea pigs of approximately the same age and weight, inoculated with the same dose of the same strain of tubercle bacilli and living under the same conditions, run a fairly uniform and typical weight curve. This weight curve may therefore be used in testing the effect of various methods of treatment and is a more reliable standard than the duration of life. Most chemotherapy, so far as tested, even though the drugs and doses used are so nontoxic as not to interfere materially with the duration of life or with the weight curves of normal, uninfected guinea pigs, tends to alter materially the type of weight curve of infected animals. This alteration consists in the main in a diminution in height of the ascending curve and an increase in length of the descending curve. It may be inferred that the more closely the weight curves of tuberculous animals treated by any method adhere to the normal weight curve, the more benefit we may hope for from the treatment.—*Weight Curves of Tuberculous Guinea Pigs. Studies on the Biochemistry and Chemotherapy of Tuberculosis; XX, Lydia M. DeWitt, J. Infect. Dis., November, 1920, xxvii, 503.*

Increased Arterial Tension in Tuberculosis.—Too low a blood pressure is the rule in pulmonary tuberculosis especially during active extensions of the processes, and often one of the first signs of recovery is the rise of blood pressure. There are, however, cases of tuberculous hypertension without any known cause, such as diabetes, obesity, superalimentation, cardiovascular

or renal disorders, syphilis, drugs, etc. These cases are not very common, the author having seen only 15 out of 300 and he is inclined to attribute the hypertension to the interference with the functions of the organs regulating blood pressure by the toxins from some sort of microörganisms. In these cases, the variations in blood pressure are very often exaggerated although the force of the heart is well marked and there is tachycardia increased by effort. The general condition is good; a very constant symptom is the tendency to hemoptysis, very often especially marked in spring and fall, analogous to the congestive hemoptysis of Dumarest. The clinical course of the disease in these cases is very quiet; there is no fever except when there is hemoptysis. The prognosis is favorable and the reduction of the hypertension is a good sign of recovery. In the treatment of these patients, it is best not to use tuberculin, nor creosote, nor guaiacol, nor calcium. The essential treatment consists in the use of the hypotensive medications, trinitrine, emetine, etc. These tuberculous cases of hypertension should avoid eating too much meat. They should not have coffee or tea or alcohol, and only towards the end of the cure should they be permitted to drink red Bordeaux, which is rich in tannin. A dry climate of the plains is advised, for altitude or sea air may very often cause congestion of the lungs. It is not necessary to insist upon a rest cure and indeed, in some cases, occupation is especially indicated. In a case of hemoptysis, if it is slight, a short rest in bed will suffice, together with cathartic and hypotensive treatment. If the hemoptysis is more abundant, it may be treated a little more seriously, by intramuscular injections of emetine.—*L'hypertension du tuberculeux; son traitement, Colbert, J. d. Méd. & d. Chirurg. Prat., September 25, 1919, xc, 689.*

Hemoptysis.—In 85 per cent of 157 hemoptysis patients the course of the tuberculosis was comparatively mild. In 50 per cent there had been an acute exacerbation before the hemoptysis, and in 37 cases with recurring hemoptysis the mild character of the disease had not been modified. In 46 cases there was no fever at any time while under observation. Hence, the hemoptysis in itself cannot be incriminated for the acute exacerbations in the graver cases. Under strict bed rest and morphine, the tendency to hemorrhage rapidly subsided. Visiting and and loud speaking are forbidden; only cool, fluid food is allowed, and the bed linen and clothing are not changed during the first few days, merely covered with clean if spotted. An ice bag to the chest helps to immobilize the patient. In the rebellious cases, a mixture of 0.1 gram each of lead acetate and pulverized digitalis leaves is administered five times a day, never for more than a week and usually only for four or five days at most. Only in 8 of 157 cases was this called for either by the tenacity of the hemorrhage or its increasing intensity.—*Haemoptysens Forhold til Lunge-tuberkulosens Exacerbation samt Bemaerkninger om dens Behandling, I. Rosenthal, Ugeskr. f. Laeger, July 29, 1920, lxxxii, 973.*

Effect of Pulmonary Tuberculosis on Vital Capacity.—Vital capacity varies considerably in different occupations and modes of living. It is affected by fatigue. Dreyer studied the effect of pulmonary tuberculosis on the vital capacity of 150 tuberculous patients at the Brompton Hospital, London. He was able without seeing the cases, but simply from the measurements, to classify these persons as normal or as mild, moderate and severe tuberculosis in practically absolute agreement with the clinical diagnosis. The authors, endeavoring to prove or disprove Dreyer's observations, studied the vital capacity of 174 patients, of whom 117 were cases of disease of the respiratory tract, including 90 definitely tuberculous. From the observations it appears that pulmonary tuberculosis has a definite influence on the vital capacity. The latter decreases in relation to the body weight as the disease progresses, being in direct proportion to the amount of disease present. It increases as the lung heals and the patient's condition improves. With active disease, it indicates slight variations in the patient's condition before there is a noticeable change in his symptoms and signs. It appears that the careful study of the vital capacity in its proper relationship to other body measurements will give important information in the diagnosis of pulmonary diseases, especially tuberculosis. It will aid in the accurate classification of the cases, and in determining the progress of the disease and the influence of treatment. It is a simple and harmless method of determining the patient's actual physical fitness or limitations.—*A Study of the Effect of Pulmonary Tuberculosis on Vital Capacity: First Report, F. W. Wittich, J. A. Myers and F. L. Jennings, J. Am. M. Ass., November, 1920, lxxv, 1249.*

Which Lung is Most Frequently Involved in Tuberculosis?—After summarizing the observations of Strandgaard at Boserup and Cavalcanti at Davos, Mayer proceeds to analyze the first 2500 cases from Turban's Sanatorium. His results, in the

main, corresponded with those of the other observers. The right sided lesions slightly outnumbered the left. He tabulates the cases as follows:

STAGE	NUMBER	PER CENT
Preponderating right-sided lesion		
I	288	47.60
II	480	54.86
III	496	48.63
Total	1264	50.58
Both sides equally involved		
I	16	2.64
II	10	1.14
III	8	0.78
Total........	34	1.36
Preponderating left-sided disease		
I	301	49.76
II	385	44.00
III	516	50.59
Total........	1202	48.08

The predilection of the right apex for tuberculosis is the result of the asymmetrical branching of the vessels and bronchi in a three lobed lung. Because of poor aeration, the retention of pathogenic organisms, once they have gained access to the lung, is favored and because of poor circulation, disease, once started, becomes progressive.—*Welche Lunge erkrankt am häufigsten an Tuberkulose? A. E. Mayer, Münch. med. Wchnschr., August 6, 1920, lxvii, 935.*

Comparison of Staining Procedures for Tubercle Bacilli.—The authors commend their modification of the Spengler method for the demonstration of tubercle bacilli. After the smear has been stained, in the usual manner, with carbolfuchsin solution, it is decolorized for twenty seconds with a 15 per cent nitric acid solution. It is then briefly rinsed and again treated for ten seconds with nitric acid; rinsed again and afterward counterstained for about thirty seconds in Spengler's picric-acid-alcohol mixture (saturated aqueous picric acid and absolute alcohol, equal parts). The smear is again rinsed and allowed to dry and is now ready for microscopic study. Out of 170 sputum specimens the Ziehl-Neelsen method yielded 59 positives and the Spengler original method gave 61, whereas the modification just described furnished 62 positives. Furthermore the average number of bacilli visible in the field was 31 for the modification, 26 for the Spengler original method and only thirteen by the Ziehl-Neelsen method.—*Neue Färbungsverfahren für Tuberkelbasillen, K. W. Zötten & P. Haarmann, Münch. med. Wchnschr., June 11, 1920, lxvii, 692.*

Toxicity of Tubercle Bacilli Products.—The autolysate or water-lysate of virulent or avirulent, human or bovine, tubercle bacilli in proportion of four parts by volume of bacilli to ten of fluid possesses no toxicity for mice when injected intraperitoneally in a single dose of one cc., nor for guinea pigs in a single intraperitoneal injection as large as 10 cc.—*The Primary Toxicity of Certain Preparations from Tubercle Bacilli for Mice and Guinea Pigs, H. J. Corper and M. Moore, J. Infect. Dis., November, 1920, xxvii, 499.*

Chemical Composition of the Tubercle Bacillus.—Goris has studied three phases of the chemistry of the tubercle bacillus and gives an extensive review of the work already done on each. I. Organic constituents chiefly lipoids, are considered. Previous investigators have shown that by the use of suitable lipoid solvents, as chloroform, alcohol, ether, benzene, and xylol, about 40 per cent of the dry weight of the organism may be extracted. The extract contains a wax which consists partly of an ester of an alcohol of high molecular weight, the fatty acids, oleic, lauric, palmitic, stearic, and arachidic, a phosphatid, probably lecithin, and possibly a substance of the group of cholesterols. Goris used large quantities of a mixture of human and bovine bacilli grown on glycerol broth, killed at 110°, filtered, washed, thoroughly dried and triturated. Approximately 40 per cent of the dried material dissolved in chloroform. The crude lipoid melted at 42°. Its index of saponification was 124.4, of acidity 37.0, and of esterification 87.4. The Hehner number (sum of insoluble fatty acids and nonsaponifiable lipoids) was 69.77 and the I number 16.22. Four partitions were made of the chloroform solution. First, a substance which proved to be insoluble in ether separated out on concentration of the chloroform. This substance, not previously described, Goris calls hyalinol, referring to its physical appearance. The mother liquor was

evaporated to dryness and the residue taken up in boiling acetone. A residue was left, and on chilling the acetone more was deposited. Finally the cold acetone solution was evaporated to dryness. The hyalinol made up 1 per cent of the dry weight of the bacilli and 2.5 per cent of the lipoid. It melted at 175°, softening between 160–165°. It was hard and elastic, and quite insoluble in water, alcohol, acetone, and ether. On purification by repeated solution in chloroform and precipitation with ether it analyzed as follows: C 55.5 per cent, H 7.15 per cent, O by difference 37.35 per cent. On saponification it yielded an unknown substance and a mixture of crotonic and isocrotonic acids. The waxy material, insoluble in acetone, contained N and P and stearic and palmitic acids apparently in substances of the phosphatid group, and lauric acid in combination with an alcohol of high molecular weight, melting at 64°, corresponding to descriptions of "mykol." A sulphur containing substance and an alcohol melting at 100° were also present. In the acetone soluble fraction glycerides of butyric, caproic, oleic, palmitic, stearic, and arachidic acids were identified. Cholesterol could not be identified surely in the lipoids of the tubercle bacillus, although a substance was encountered which in chloroform solution gave a weak coloration like that of cholesterol with sulphuric acid on prolonged standing. After the chloroform extraction the lipoid free, redried bacilli were taken up in water and the water-soluble, alcohol-insoluble substances precipitated with 2–5 volumes of alcohol. The precipitate was a nucleoprotein containing N and P and a hexose. It was toxic for tuberculous guinea pigs. The water- and alcohol-soluble fraction contained protein split products, among which tyrosine and leucine were easily identified. Neither monoses nor polyoses were present. A search for enzymes in the tubercle bacillus was made and no sugar-splitting one encountered. II. The mineral composition of the tubercle bacillus was next determined. The ash made up 2.5 per cent of the dry weight, of which 43.4 per cent was P_2O_5, 22.8 per cent H_2SO_4, 11.6 per cent Na, 9.7 per cent Ca, 7.7 per cent K, and 5.7 per cent Mg. Traces of Fe and Mn were found. The crude lipoid gave 1.17 per cent ash, largely phosphate, the figure for the latter indicating that about 5 per cent of the lipoid was lecithin. III. Finally the problem of acid-resistance was studied. Much confusion exists on this subject, acid-fastness having been attributed by various authors to a difficultly permeable membrane, or to substances within the body with a strong affinity for the fuchsin stain, protein in nature according to some, chitinous according to others, and lipoidal according to others, the best evidence probably being for the latter. Goris and Liot found that completely defatted bacilli were not acid-fast. Of the lipoid substances hyalinol was found to be non-acid-fast, while the solid fatty acids were moderately acid-fast, and the mykol strongly so. Tests of acid-fastness were made by impregnating paper strips with a chloroform solution of the lipoid in question, drying, soaking in hot carbol fuchsin solution 5 minutes, and then destaining in 25 per cent H_2SO_4, aclohol at 60°, and finally water.—*Composition chimique du bacille tuberculeux, I. A. Goris, II and III. A. Goris and A. Liot, Ann. d. l'Instit. Pasteur, 1920, xxxiv, 497.*

Chronic Intraocular Tuberculosis.—Ocular tuberculosis is most frequently transmitted by means of the blood stream, especially the veins. An important etiologic factor is trauma. All tissues of the eye except the lens are susceptible to infection. Involvement of more than one tissue of the eye, such as iritis with choroiditis, scleritis with keratitis, or other combinations should arouse suspicion of tuberculosis. The author describes the characteristic appearance of the lesions in the various layers of the eye. The most reliable diagnostic method in afebrile cases is the subcutaneous injection of tuberculin. Patients with recent activity in the lungs are started on a combined diagnostic and therapeutic dose of 1: 50,000, which is doubled until reaction occurs. Patients who had activity several years before, and have apparently been well for a number of years, are started with 1: 10,000. Patients with no history of activity receive an initial dose of 0.5 to 1 mgm., followed every 48 hours by 2, 3, to 5 mgm., up to the point of saturation. Tuberculin treatment often is not continued long enough. A favorable result is proof that the lesion was tuberculous. Change to other forms of tuberculin should be made when treatment with one form was unsuccessful.—*Diagnosis of Chronic Intra-Ocular Tuberculosis, H. H. Stark, J. Am. M. Ass., October 2, 1920, lxxv, 923.*

Ocular Tuberculosis.—The manifestations of tuberculosis which the ophthalmologist is called upon to diagnose or treat are located most frequently in the choroid. Tuberculosis of the choroid occurs in three fairly distinct forms: Choroiditis exudativa, miliary tubercle and conglobate tubercle. The first is the most common. The exudate may be disseminated or discrete; it first appears in yellowish patches with a hazy edge which later on become pure white and

sharply defined. [illegible] may become arrested. If it [illegible] develop in the vitreous, the lens [illegible] opaque, the retina detaches and atrophy of the globe follows. The symptoms vary from slight impairment of vision to blindness. There are subjective sensations of light in the early stages. Miliary tubercles of the choroid are much rarer. They are 0.5 to 1 mm. in diameter, often multiple. They represent the typical miliary tubercle and occur in patients with miliary, bone and joint tuberculosis and tuberculous meningitis. They are of great diagnostic importance. The conglobate tubercle of the choroid is a tuberculous nodule often appearing as a small tumor projecting into the vitreous. It may be hard to differentiate from sarcoma. If the diagnosis is in doubt, the eye should be removed. Retinal tubercle is usually connected with a vein or artery, most frequently the former. It is the most common cause of recurrent retinal hemorrhage. Tuberculosis of the cornea usually resembles syphilitic interstitial keratitis so closely that a clinical differentiation is impossible. The diagnosis of tuberculosis of the eye may at times be made clinically, especially in cases of anterior uveitis. Choroidal and retinal tubercles may be recognized with the ophthalmoscope. In the majority of cases, however, the diagnosis is arrived at by injection of tuberculin. After a complete physical examination a diagnostic injection of O.T. is given in doses of 0.1 mgm. for children to 1 mgm. for adults. This dose is doubled and repeated in twenty-four hours; if no reaction occurs, a third dose of 5 mgm. is given 48 hours later. A focal reaction in the eye is diagnostic, a general reaction with fever only suggestive. The prognosis of ocular tuberculosis is grave. Treatment consists in general hygienic and dietetic measures, removal of all foci of infection, even though they appear to have no relation to the tuberculous process. Locally, atropin is useful by putting the ciliary muscle at rest. The specific treatment consists in injections of T.R. At first one fifty thousandth of a mgm. is given every five days and the dose gradually increased so that at the tenth injection the patient receives one five thousandth of a mgm. If a focal or general reaction should occur, the dose must be reduced. A dose of one hundredth of a mgm. once a week is not exceeded. These injections may have to be kept up for months. A report of 4 cases of ocular tuberculosis observed at the Bellevue Hospital (N. Y. City) follows.—*Ocular Tuberculosis, F. B. Bogardus, Am. J. Ophthal., September, 1920, iii, 661.*

Ileocecal Tuberculosis.—[illegible] the [illegible] the [illegible] and [illegible] explained by the fact that the [illegible] primarily involved or [illegible] colon or small intestine. The [illegible] diagnosis has to consider acute [illegible] inflammatory and neoplastic [illegible] appendix itself and [illegible] parts [illegible] the small and large intestine, affections [illegible] the omentum, mesentery, lymph nodes, the adjacent part of the genitourinary tract and the cellular tissue of the retroperitoneal space. Local evidence, such as furnished by the cystoscope or X-ray, is conclusive. Few errors should occur in the more chronic forms of the disease. In the acute cases accuracy often is not possible until the lesion is exposed during the operation. Fortunately, in the majority of such patients, the indications are the same. A roentgenographic picture showing hypermotility and spasm or filling defects in a patient with pulmonary tuberculosis should lead to a definite diagnosis of colonic tuberculosis. The procedure of choice is a clean resection of the ileocecal junction extending well into the healthy portions on either side. It is safest to close completely the stumps of the bowel and to reëstablish the continuity of the intestine by side to side anastomosis. Fecal fistula is a common complication of the postoperative period of ileocecal tuberculosis, and the sinus persists for long periods of time, because of the communication with the interior of the bowel.—*Ileocecal Tuberculosis, A. O. Wilensky, N. York M. J., November 13, 1920, cxii, 768.*

Occluded Renal Tuberculosis.—Renal occlusion may occur so insidiously that but few subjective symptoms accompany the process. Among the most common etiologic factors are renal tuberculosis, ureterolithiasis and nephrolithiasis, carcinoma of the bladder, pyelonephritis and renal atrophy, stricture of ureter following infection other than tuberculosis, operative trauma, pressure and involvement by abdominal neoplasms. There were 621 patients operated upon for renal tuberculosis from January, 1900, to January, 1919, at the Mayo clinic. In 69 of these the affected kidney was found to be occluded. The clinical symptoms often reflect the time of occlusion. The patient usually has previously had a period of marked polyuria and dysuria which suddenly diminished or ceased; the constitutional symptoms improved, with gain in weight. Renal occlusion occurs virtually twice as often in the

male as in the female. It is most frequent in adults in the fourth and fifth decade. It occurs in about ten per cent of the cases of chronic renal tuberculosis and can be recognized by means of clinical, roentgenographic and cystoscopic data in fully ninety per cent. The usual symptoms are persistent frequency, dull pain or abdominal tumor, usually lasting many years. At first the occluded kidney may be a focus of infection, but after many years it usually becomes sterile. In the presence of persistent frequency, dull pain or abdominal tumor, nephrectomy is indicated. The postoperative results are usually excellent, with recovery from the various symptoms. In cases of bilateral tuberculosis, the removal of an occluded kidney will not benefit the patient and operation should not be performed.—*Occluded Renal Tuberculosis, W. F. Braasch, J. Am. M. Ass., November 13, 1920, lxxv, 1307.*

A Complicated Case of Renal Tuberculosis.—A male, 46 years old, had an external urethrotomy performed for acute retention October, 1915. He was readmitted March, 1918, for right inguinal abscess which was opened; two weeks later the wound had practically closed and the patient was discharged. He was readmitted May, 1919, for left inguinal abscess. A small sinus in the perineum and a large amount of pus in the urine were found. Culture of the abscess showed B. coli. The patient was readmitted December 12, 1919, with numbness of the feet and inability to walk. The inguinal sinus had drained more or less constantly since May and was still draining thin pus. The scrotum was red and tender, the perineum red and brawny with one or two small fistulae. There was incontinence of urine and feces, general weakness and involuntary twitching of the leg muscles, diminished sensation up to the level of the 10th or 11th dorsal vertebra, saddle area of anesthesia about the tip of the coccyx. X-ray examination revealed a large shadow, shaped like the renal pelvis, on the left side. External urethrotomy, excision of sinuses and scar tissue and drainage of a large perineal abscess were performed. Nephrectomy revealed a kidney containing a large stone. The microscopic appearance was that of tuberculosis. On February 3, the patient was discharged with the perineal wound practically closed, the inguinal sinus completely closed, and the motility of the legs and sensation returning. He subsequently gained 15 to 20 pounds, feels strong now, is able to walk without difficulty, the sensations and sphincters are normal. Although this patient was under more or less constant observation since 1915, there was nothing at any time to arouse the suspicion of renal tuberculosis, stone, or any other kidney lesion. The author has never seen transverse myelitis as a complication of renal sepsis of any sort. Search of the recent literature has thrown no light on the subject. The development of transverse myelitis may be explained by a direct extension of the septic process to the epidural space or to toxic origin. The latter is more likely. Calculus in a tuberculous kidney is uncommon. No cases were found in the literature. It was the first case of inguinal renal fistula ever seen at the Massachusetts General Hospital. Search of the literature reveals an almost equal paucity of material for the last 20 years. Formerly renal fistula either as a preoperative complication or as a postoperative result was by no means rare. It is encouraging to realize that owing to the greater tendency of patients to seek earlier relief for their ills, to more accurate and earlier diagnosis, and to better surgery, what was once a not uncommon condition has become practically extinct.—*Renal Tuberculosis Complicated by Inguinal Renal Fistula, Transverse Myelitis, and Renal Calculus, J. D. Barney and W. J. Mixter, J. Urol., August, 1920, iv, 391.*

The Kidney in Pulmonary Tuberculosis.—The kidney is normal in the majority of cases of pulmonary tuberculosis, but the principal lesions that this organ may present are amyloid degeneration, chronic nephritis and acute morbid processes. During the evolution of pulmonary phthisis amyloid degeneration will first develop in the liver, spleen, and suprarenal capsules before attacking the kidney, and it is not uncommon to find a massive amylosis of these viscera while only a few glomeruli and some arteriolae of the pyramids will offer an amyloid infiltration. At this phase of the process, excepting in cases where some chronic lesion preëxists, there usually is no clinical symptom of nephritis and only an albuminuria or a polyuria will occasionally direct the physician's attention to the kidney. In these cases, a study of the urinary secretion will reveal a most peculiar syndrome; on the one hand there is a considerable drop in Ambard's coefficient, and on the other, in spite of a sufficient chloruria, the percentage of the chlorides of the serum is below the level of normal secretion. It is consequently to be supposed that these signs indicate an exaggeration of the renal power of concentration—a kind of hypersecretion. When a histological examination can be made in good conditions, a peculiar hypertrophy of the cells of the tubuli will be found, which seems to be the histologic evidence of

hypersecretion. From the practical standpoint, this urologic syndrome in a tuberculous subject should lead to the diagnosis of amyloid degeneration of the kidneys before the advent of extensive edema, massive albuminuria and incorrigible diarrhea. An ordinary Bright's disease may be met with in pulmonary tuberculosis and usually the inoculation of the urine or a bit of the renal tissue will remain negative, but a positive result is not in itself sufficient to regard a vulgar nephritis as due to the bacillus of tuberculosis. A syndrome of nephritis may depend upon certain tuberculous infiltrations of the kidney—real follicular nephritides. Finally, Koch's bacillus may provoke certain atypical lesions of the kidney, such as a secondary sclerous reaction invading the tubercle, or an interstitial infiltration which, from the onset, is unlike the classic follicle. In the kidney the connective tissue reaction is much more common. The sclerosis forms local cicatrices which for a long time are infiltrated with round cells and in which the presence of the tubercle bacillus can be demonstrated. The remainder of the cortex, even the areas adjacent to the tuberculous lesion, remain intact for a long time. In those cases where the most extensive lesions have produced the syndrome of both chloride and nitrogenous retention, this special character of tuberculous sclerosis, will also be found, and given these data, it is unlikely that the tubercle bacillus can be incriminated in ordinary Bright's disease of tuberculous patients. Koch's bacillus can provoke acute generalized lesions of the kidney under peculiar circumstances, but two elements are necessary for their production. On the one hand, a subject in the state of allergy, sensibilized for certain doses of antigen by the infection of the first inoculation which he has received—such is the case of the phthisical subject; on the other, a massive reinoculation of Koch's bacilli by way of the blood and also, perhaps, by its soluble toxins, an acute reaction to tuberculin being manifest. Such a bacillemia suddenly occurring may cause death with hardly any clinical reaction and it alone can explain the generalized acute lesions of the kidney, lesions paradoxical in appearance found at autopsy of certain cases of chronic pulmonary tuberculosis. Some instances of terminal acute nephritides represent the same pathogenesis. A less intense allergic reaction likewise undoubtedly explains certain acute hemorrhagic nephritides of a temporary kind that clinically represent a true Koch's phenomenon in the kidney.—*Editorial, Med. Rec., November 20, 1920, xcviii, 862.*

Associated Lung and Joint Tuberculosis.—In cases of simultaneous affection of lungs and joints, the prognosis depends on which process began first, as the second process acts like a derivation or a fixation abscess, diverting the disease to this second point. When this second process occurs in the lungs, these vital organs soon become compromised, but when the process of derivation is in a limb, it does comparatively little harm, and this second process should be encouraged rather than suppressed. Hence the prognosis is comparatively favorable when the bone or joint process had developed secondarily to the pulmonary process. A few instances of each type are cited, and also some cases which show the disastrous results when a secondary bone or joint process was operated on and cured, thus depriving the primary lung process of this outlet. On the other hand, benefit resulted when a primary bone or joint process was operated on and cured, the necessity for the lung's sacrificing itself thus being done away with.—*Considérations cliniques sur les tuberculoses mixtes (pulmonaires et ostéo-articulaires), A. Jacquemin, Bull. Méd., September, 1920, xxxiv, 835.*

Stigmata of Predisposition to Bone and Joint Tuberculosis.—Rivers found that in cases of bone and joint tuberculosis red and reddish hair is nearly twice as frequent as in the ordinary population. As to the situation of the tuberculous lesion, the spine was rarely attacked in the red haired. Hardly more of them than of the others had multiple tuberculous lesions. Permanent freckling was a little commoner in bone and joint tuberculosis than is normal. The percentage of ichthyosis was 1.6. It is at least twice as frequent in bone and joint tuberculosis as in nontuberculous children.—*Stigmata of Predisposition to Bone and Joint Tuberculosis, W. C. Rivers, Brit. J. Child. Dis., July-September, 1920, xvii, 140.*

Exophthalmic Goitre and Tuberculosis.—Sergent is inclined to accept a causal relation when symptoms of exophthalmic goitre develop in the course of tuberculosis. The great danger is that persons with merely exophthalmic goitre may be classed as tuberculous and sent to a sanatorium, where they acquire tuberculosis and the mistake is never discovered. Many of the symptoms are common to both, the unstable temperature and pulse, variable blood pressure, menstrual irregularities, the bright eye, burning cheeks, sweats, emaciation, early fatigue, asthenia, diarrhea, and pain in the celiac plexus and in the intestines, but the

most misleading symptoms of hyperthyroidism are the short dry, spasmodic cough and the tendency to shortness of breath on exertion. The rhythm of breathing is staccato, spasmodic. Differentiation is possible only by recognizing the clinical picture of thyroid overactivity on the one hand and absolutely excluding active tuberculous lesions on the other hand. Especially at the two extremes of the sexual life of women, at puberty and the menopause, we should be on the alert to detect hyperthyroidism. The instructive examples reported are all in women, but there are also men whose overactive thyroid led to erroneous treatment for tuberculosis.—*Syndrome du Basedow et tuberculose, E. Sergent, Paris Méd., July 24, 1920, x, 80.*

Tuberculosis and Influenza.—From a review of the literature, from replies to a questionnaire and from studies of the history of the epidemic as it affected the patients in Massachusetts sanatoria (2000 cases) and from an investigation of their present condition the following conclusions were drawn: Eternal vigilance is the price of safety. We must regard any patient who comes down with a cold or other acute symptoms, whether or not he has tuberculosis, as a possible case of influenza and a source of contagion. Although it is quite possible or rather probable that the tuberculous patient does possess a certain degree of immunity against influenza, this must not be taken for granted and every effort must be made to prevent his getting it. The treatment of the tuberculous patient with influenza is the same as that of the person without tuberculosis and should be based on rational lines of rest, elimination and stimulation when necessary. It should be regarded at all times as a serious but by no means a hopeless or fatal complication. Postinfluenzal bronchitis and debility are real and definite clinical entities but in many cases they serve merely to disguise a newly awakened pulmonary tuberculosis. In every case of influenza when there is either a cough or prolonged physical depression following the disease, the patient should be kept under careful and constant supervision. The early diagnosis of pulmonary tuberculosis, always a difficult task, has been made increasingly so on account of influenza and its effects. While undoubtedly many cases of tuberculosis have been discovered or made active on account of influenza, there are numerous patients who have been wrongly classified as consumptives owing to signs and symptoms, constitutional and referred to the lungs that were really due to influenza and not to tuberculosis. Care, conservatism and common sense are needed now more than ever in handling this difficult problem.—*Tuberculosis and Influenza, J. B. Hawes, 2nd, Boston, M. & S. J., November 18, 1920, clxxxiii, 596.*

Open Pulmonary Tuberculosis in Infants.—All cases in infants which show clinical signs of pulmonary tuberculosis should be considered as open whether bacilli can be detected in the sputum or not. The sputum is hard to obtain, and repeated examinations of it are often negative. There is a lack of guinea pigs for diagnostic purposes in Germany. The stools, moreover, have failed to show tubercle bacilli. A case is cited which undoubtedly infected three adult attendants and five other children. These cases are especially dangerous because of the high position and shortness of the infantile larynx which retains little of the sputum and favors droplet infection with any violent expiration.—*Zur Frage der offenen Lungentuberkulose im Säuglingsalter, Klotz, Münch. med. Wchnschr., August 13, 1920, lxvii, 964.*

Hemolytic Test for Tuberculosis.—Letulle relates that the National Antituberculosis Society has recently officially advocated the Calmette-Massol technic for the complement deviation test as an aid in the early diagnosis of tuberculosis. He describes it in detail and commends it further for the diagnosis of syphilis as well. The principle of the test is the adding of progressively increasing amounts of complement to a constant amount of serum and of antigen.—*La technique de Calmette et Massol pour la reaction de Bordet-Wassermann, M. Letulle, Presse méd., August 25, 1920, xxviii, 588.*

Complement Fixation.—This investigation was undertaken with a view to ascertain if it were possible to obtain sufficiently reliable results to warrant regarding the reaction as specific for the diagnosis of active tuberculosis. The conclusions drawn from the results are: (1) A negative reaction is as reliable an indication of the absence of an active tuberculous lesion as a positive reaction is of its presence. (2) The complement fixation test is a specific means of diagnosis of the presence of an active or recently active lesion. (3) A positive reaction in the highest dilution of complement is just as reliable an indication of the presence of such a lesion as a positive reaction in all three dilutions.—*The Complement Fixation Test in Pulmonary Tuberculosis: Its Use as a Means of Diagnosis, A. L. Punch, Lancet, September 25, 1920, cxcix, 647.*

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